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KOOTENAI RIVER FISHERIES INVESTIGATION: STOCK STATUS OF BURBOT AND RAINBOW TROUT AND FISHERIES INVENTORY

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TABLE OF CONTENTS

	Page
ABSTRACT	1
INTRODUCTION	2
STUDY AREA	5
GOAL	6
OBJECTIVES	6
METHODS	6
Sampling Burbot	6
Search for Spawning Burbot	7
Burbot Fishing Questionnaire	7
Burbot Telemetry	7
Electrofishing the Kootenai River	8
Population Estimates at the Hemlock Bar	8
Relative Abundance and Trophic Structure	8
Sampling Tributary Streams	9
Angler Effort and Harvest	9
Zooplankton Sampling	10
RESULTS	10
Hoop Net Sampling	10
Total Catch	10
Burbot	10
Search for Spawning Burbot	13
Burbot Fishing Questionnaire	13
Burbot Telemetry	13
Movement	13
Habitat	13
24-Hour Telemetry and Spawning Season	15
Mortality	15
Kootenai River Electrofishing	15
Population Estimates at the Hemlock Bar	15
Rainbow Trout	15
Cutthroat Trout	18
Mountain Whitefish	18
Relative Abundance and Trophic Structure	18
Sampling Tributary Streams	18
Stream Dimensions	18
Stream Electrofishing Catch	23
Trout Abundance	23
Fish Population Estimates and Standing Stocks	23
British Columbia Tributaries to the Kootenai River	23
Sport Fishery	28
Total Catch and Effort	28
Zooplankton Sampling	28

TABLE OF CONTENTS

Page

DISCUSSION 34

Burbot Population Status 1993-1994 34
Burbot Telemetry 34
Physical and Biological Variables That May Affect Burbot 35
Replication of Burbot Sampling 36
Kootenai River Productivity 36
Trout and Tributary Streams 41
Sport Fishery 41
Rainbow Trout Synopsis 42

RECOMMENDATIONS 42

ACKNOWLEDGEMENTS 43

LITERATURE CITED 44

APPENDICES 48

LIST OF TABLES

Table 1. Hoop net catch success by number, weight (kg), and catch per unit effort[a] (CPUE), Kootenai River, Idaho, October 1993 through May 1994 11

Table 2. Summary of sonic telemetry data and physical characteristics of six burbot in the Kootenai River, Idaho, and Kootenay Lake, British Columbia, Canada 14

Table 3. Single pass electrofishing catch from three river reaches in the Kootenai River, August 1994, and trophic level for each species: Ins - insectivore, Pla - planktivore, Omn - omnivore, Herb - herbivore, and Ins-Pisc - insectivore piscivore 20

Table 4. Length, mean width, and area of tributaries to the Kootenai River, Idaho, that were sampled July-September 1994 22

Table 5. Single run electrofishing catch (per 100 m^2) in natural stream reaches of 16 tributaries of the Kootenai River, Idaho, July-September 1994. The catch per 1,000 m is subtended 24

Table **6.** Catch, recapture, population estimates, density, and estimates of standing stocks of species of fish from five streams in the Kootenai River drainage. Catches were made by backpack electrofishing, July-September 1994 27

Table 7. Estimated effort and harvest of fish by period (95% confidence intervals are subtended), Kootenai River, Idaho, 1993-1994 29

CONTENTS

Page

Table 8. Estimated catch (C) and harvest (H) rates (catch/h) for anglers fishing the Kootenai River, Idaho, March 1, 1993 - February 28, 1994 31

LIST OF FIGURES

Figure 1. Location of the Kootenai River, Kootenay Lake, Lake Koocanusa, and major tributazies in Idaho. The river distances are in river kilometers (rkm) and are indicated at important access points. The Hemlock Bar is indicated by the cross-hatched area at rkm 261 3

Figure 2. Mean monthly discharge of the Kootenai River at Porthill, Idaho, from 1961 through 1971 (pre-Libby Dam) and from 1972 through 1981 (post-Libby Dam). Figure adopted from Partridge (1983) 4

Figure 3. Length frequency distribution of burbot caught by baited hoop nets in the Kootenai River, Idaho, March through May 1993 and October 1993 through June 1994 . 12

Figure 4. Contour map of the pool at the base of Ambush Rock, transects, and the location (X) of four burbot as detected with sonic telemetry, November 1993 through May 1994, Kootenai River 16

Figure 5. Length frequency distribution of rainbow trout sampled by electrofishing the Hemlock Bar of the Kootenai River, 1993 17

Figure 6. Length frequency distribution of mountain whitefish sampled by electrofishing Hemlock Bar of the Kootenai River, 1993 19

Figure 7. Trophic structure of the fish community of three reaches of the Kootenai River. The top left figure is the Hemlock Bar community, top right is the Porthill community, and the lower figure is rkm 250. Samples taken by electrofishing, July 1994 21

Figure 8. Length frequency distribution of rainbow trout and brook trout sampled by electrofishing Ruby Creek, Idaho, 1994. Ages were determined by scale analysis of subsamples from populations and subjectively fitted to peaks of the distributions 26

Figure 9. Harvest of six species of fish and their total from the Kootenai River, March 1, 1993 through February 29, 1994. Abbreviations are: rainbow trout - R trout; cutthroat trout - C trout; mountain whitefish - WHF; northern squawfish - SWF; rainbow x cutthroat - Hybrid 30

Page

Figure 10. Temporal distribution of zooplankton sampled at mid-day by a verticle haul from the Kootenai River, 1994 33

Figure 11. Trophic structure of the fish community of two reaches of the Kootenai River. The left figure is the Hemlock Bar community and the right figure is the Porthill community. Data is from Partridge (1983); samples taken by electrofishing, July 1982 38

Figure 12. Back-calculated length at age for mountain whitefish in the Kootenai River, 1982 (Partridge 1983) and 1993 39

Figure 13. Back-calculated total length of rainbow trout in the Kootenai and Spokane rivers (Davis 1991) 40

LIST OF APPENDICES

Appendix A. Ling fishing questionnaire 49

Appendix B. Location (rkm), date, depth, water temperature °C, of burbot 446 as determined by sonic telemetry and X16 Lawrence graph recorder 50

Appendix C. Location (rkm), date, depth, water temperature °C, of burbot 374 as determined by sonic telemetry and X16 Lawrence graph recorder 51

Appendix D. Location (rkm), date, depth, water temperature °C, of burbot 455 as determined by sonic telemetry and X16 Lawrence graph recorder 52

Appendix E. Location (rkm), date, depth, water temperature °C, of burbot 365 as determined by sonic telemetry and X16 Lawrence graph recorder 53

Appendix F. Location (rkm). date, depth, water temperature °C, of burbot 96 as determined by sonic telemetry and X16 Lawrence graph recorder 54

Appendix G. Location (rkm), date, depth, water temperature °C, of burbot 383 as determined by sonic telemetry and X16 Lawrence graph recorder 55

Appendix H. Average back calculated total length (mm) at each annulus for each year class of mountain whitefish captured in the Kootenai River, Idaho, 1993 56

Appendix I. Average back calculated total length (mm) at each annulus for each year class of rainbow trout captured in the Kootenai River, Idaho, 1993 57

ABSTRACT

I caught eight burbot Lota iota in the Kootenai River with hoop nets baited with fish; and an additional four more were caught during juvenile white sturgeon Acipenser transmontanus sampling. Burbot catch from October 1993 to April 1994 averaged <.O1 fish/net day. Total length ranged from 349 to 670 mm and weighed from 272 to 1,589 g (mean = 982 g). Seven burbot were caught at Ambush Rock, one at Deep Creek, and four at Smith Creek. No burbot were caught in early winter at traditional burbot spawning tributaries. Six burbot were implanted with sonic transmitters, released at the capture site, and located a total of 71 times from November 1993 through August 1994. Burbot preferred the habitat of the thalweg and showed no evidence of spawning. Population studies indicated rainbow trout Oncorhvnchus mvkiss numbers were similar to past studies, but mountain whitefish Prosopium williamsoni densities were substantially lower and growth was slower than previous studies. Trophic structure of some segments of the Kootenai River appear to have changed since the early 1980s. Single pass sampling with a backpack electroshocker at 16 streams and population estimates at 5 additional stream sites indicated little change in the density of trout in tributaries since the early 1980s. A creel survey indicated fishing pressure on the Kootenai River has changed little since 1982, and is very low compared to other river fisheries in the Panhandle Region. We estimated an angling effort of 15,252 h at 129 h/km (± 36). Anglers caught a total of about 6,464 fish (± 3,414), of which 4,189 (± 3,266) fish were kept. Whitefish were the most abundant fish in the harvest with 1,168 (± 923) being taken, while rainbow trout were second with a harvest of 1,040 (± 905). Poor catch success for rainbow trout (.02 fish/h) and harvest of mountain whitefish (.03 fish/h) was lower than the 1982 creel. No burbot or bull trout were seen in the creel, but several bull trout were reported to have been creeled. One white sturgeon was caught and released and a second reported. Rainbow trout appear to be the least affected fish species by the changes in the Kootenai River system. Future burbot studies should focus on habitat needs, spawning locations, and early life history requirements.

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INTRODUCTION

The geologic history of the Kootenai River system can be traced back to the Wisconsin glacier and glacial Lake Kootenay (Alden 1953). Colonization of the river with a variety of fish species is thought to have occurred during this period (Northcote 1973). Many changes have occurred since then.

The Kootenai River, Kootenay Lake, and tributaries (Figure 1) of the drainage provided important fisheries to native Americans since the earliest known records, and more recently, European settlers (Northcote 1973). The Kootenai River in Idaho provides two unique fisheries to the state. The Kootenai River is the lair of the only known endemic population of burbot *Lota lota* in Idaho (Simpson and Wallace 1982) and a genetically distinct population of white sturgeon *Acipenser transmontanus* (Setter and Brannon 1990). Local newspaper archives provide photographs and stories of once popular fisheries for burbot, trout *Oncorhynchus* sp., and sturgeon. The best records of fishing activity in the Idaho portion of the Kootenai River were recorded by Partridge (1983). Partridge documented angling effort of 102 h/km in 1982, with 82% (74 h/km) of the effort for salmonids. The catch rate for trout was 0.06 fish/h. Burbot and sturgeon fishing activity comprised 18% of the total effort. Cooperating anglers fishing for burbot in 1981 reported fishing a total of 9,045 h (77 h/km) and caught 179 burbot (0.02 fish/h) (Partridge 1983). Fishing activity on the Montana portion of the river was reported to be substantially higher at 1,662 h/km.

The Kootenai River is no longer in pristine condition. Logging and mining operations as early as the 1880s caused tributary discharge to flash and physically changed the streams and caused siltation (Northcote 1973). Additional disturbances came to the drainage in 1892 with attempts to dike the lower reach of the river and claim land for agricultural uses (Northcote 1973). Mining added to the deterioration of the water quality in the tributaries and river, and from 1953 through the 1970s, operation of a fertilizer plant on the Saint Mary River added to the nutrient levels (Northcote 1973).

Disturbance of the Kootenai River ecosystem was heightened by the construction and operation of Libby Dam and impoundment of Libby Reservoir (Lake Koocanusa). Libby Dam was created under an International Columbia River Treaty between the United States and Canada for cooperative water management of the Columbia River Basin (Columbia River Treaty 1964). Construction of the dam began in 1966 by the Army Corps of Engineers. Its main purpose is hydropower production, with secondary benefits of flood control and navigation. Impoundment of Lake Koocanusa and regulation of downstream flows began in March of 1972. After completion of the dam, mean monthly flows downstream during spring were reduced by 50%, and winter flows tripled (Figure 2). Temperature also increased by 3°C (Partridge 1983). Under the present operation, the river now remains ice-free during the winter. Prior to the dam, the river froze over in many portions of the Idaho reach. Turbidity and nutrient loads in the Kootenai River have also changed because the impoundment acts as a nutrient and sediment trap (May and Huston 1979).

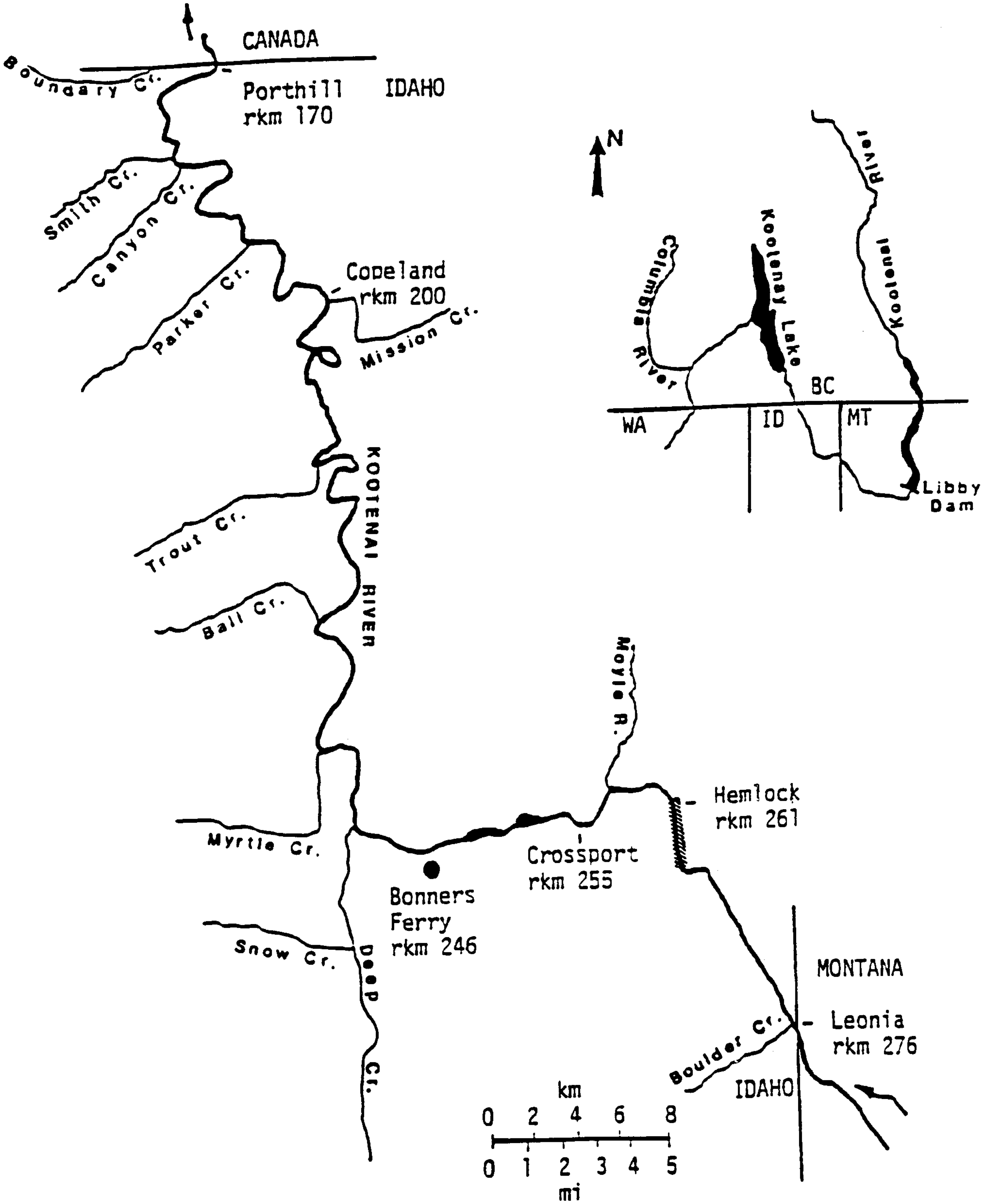

Figure 1. Location of the Kootenai River, Kootenay Lake, Lake Koocanusa, and major tributaries in Idaho. The river distances are in river kilometers (rkm) and are indicated at important access points. The Hemlock Bar is indicated by the cross-hatched area at rkm 261.

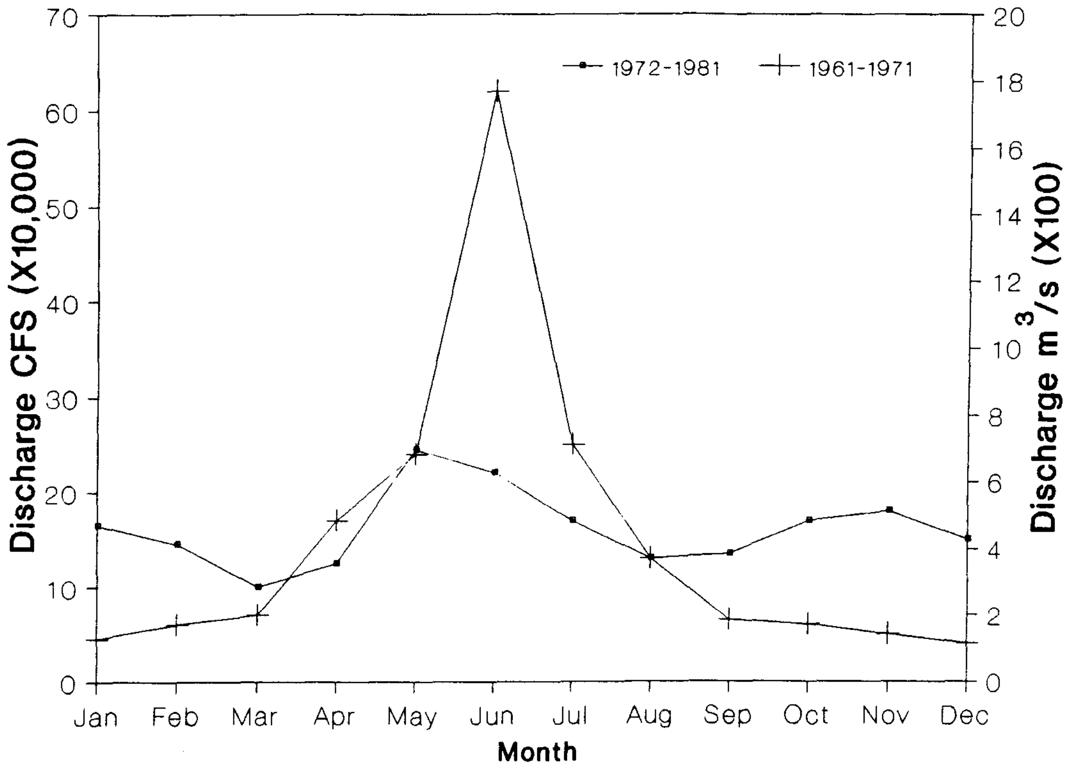

Figure 2. Mean monthly discharge of the Kootenai River at Porthill, Idaho, from 1961 through 1971 (pre-Libby Dam) and from 1972 through 1981 (post-Libby Dam). Figure adopted from Partridge (1983).

Concern for the Kootenai River fisheries in the late 1970s prompted a research investigation by the Idaho Department of Fish and Game (IDFG) (Partridge 1983). This study emphasized an inventory of the river fisheries and learning more about the environmental impacts to the white sturgeon, burbot, rainbow trout Oncorhynchus mykiss, mountain whitefish Prosopium williamsoni, and cutthroat trout O. clarki. Partridge (1983) suggested regulation of springtime discharge was the probable cause of poor recruitment of young sturgeon, the burbot population was on the decline from pre-dam abundance, the winter burbot fishery was nearly eliminated because of water management from the dam, the trout population was low, and spawning and rearing habitat for trout was limiting.

The Pacific Northwest Power Act of 1980 recognized possible conflicts resulting from hydropower development in the northwest and directed the Bonneville Power Administration (BPA) to "protect, mitigate, and enhance fish and wildlife to the extent affected by the development and operation of any hydropower projects in the Columbia River system." Under this Act, the Northwest Power Planning Council was created, and federally-funded investigations were designed to help offset the loss of natural resources.

This investigation was designed as a follow-up to the efforts of Partridge (1983) and as a companion study to the present white sturgeon investigation (Apperson 1991; Marcuson et al., in press). However, until now the needs of burbot, a species of 'special concern,' and the trout populations have not been identified. This investigation is intended to identify factors limiting burbot and trout populations, to provide management alternatives, to restore fish populations, and to improve fishing opportunities (Idaho Department of Fish and Game 1992 Fisheries Management Plan).

STUDY AREA

The Kootenai River is in the upper Columbia River drainage. It is the second largest tributary, and originates in Kootenay National Park, British Columbia (Figure 1). The river traverses south into Montana where Libby Dam impounds water back into Canada forming Lake Koocanusa. From Libby Dam, the river turns west then northwest into Idaho, then north into British Columbia and Kootenay Lake. The Kootenai River, at Porthill, Idaho, drains about 35,490 km^2, and the reach in Idaho is 106 km long. Kootenay Lake drains out the West Arm, and eventually the river joins with the Columbia River near Castlegar, British Columbia.

The Kootenai River presents two different channel and habitat types while it passes through Idaho. As the river enters Idaho, it is typified by its steep canyon walls and high gradient (0.6 m/km), but at about river kilometer (rkm) 255 upstream of Bonners Ferry, the river changes to a lower gradient (0.02 m/km) and meanders through a broad flood plain. Tributary streams of the Kootenai River are typically high gradient while they pass through mountain canyons, but revert to lower gradients when they reach the valley floor. Most of these tributary streams have been channelized at their lower reach and leveed to accommodate the levees that follow the border of the Kootenai River.

GOAL

To restore the burbot, whitefish, and rainbow trout populations in the Idaho reach of the Kootenai River and improve fishing success to historic levels.

OBJECTIVES

1. To identify factors that are limiting populations of burbot, rainbow trout, and other populations within the Idaho portion of the Kootenai River drainage, and recommend management alternatives to restore the fisheries to self-sustainable levels.

2. Determine if the burbot population **is** being limited by reproductive success, survival, and/or the recruitment of young burbot.

METHODS

Sampling Burbot

I sampled burbot in the Kootenai River with two sizes of hoop nets. The large nets were 3.66 m long with fiberglass hoops and polyvinyl chloride spreader bars 3.06 m in length (Bernard et al. 1991). Hoops had an inside diameter of 91 cm and tapered to 69 cm toward the cod end. Each net had a double throat that narrowed to an opening of about 19 cm. Netting was nylon woven into 25-mm bar mesh and had number 15 cotton twine. The smaller hoop nets were 3.05 m long and had an entrance diameter of 61 cm tapering to 46 cm toward the cod end. Web and hardware of the smaller nets was the same as the larger nets. All nets were anchored at the cod end with a 10-kg concrete weight. An orange buoy was tied to the first hoop with a length of rope to mark the net and enable me to raise it. I placed chunks of cut fish into a woven bait bag and suspended it from the second to last hoop (from the entrance) inside each net. Kokanee O. nerka, northern squawfish, Ptychocheilus oregonensis, or suckers Catostomus sp. were used as bait.

I fished six to nine hoop nets from October 15 through April 27, 1994 on the Kootenai River for a total of 887.8 net days (a net day is a single 24-h set). These nets were set in key locations where I had caught burbot in 1993 (Paragamian 1994) or at traditional fishing locations; Ambush Rock (rkm 244), Deep Creek (rkm 241), and Mission Creek (rkm 199 to rkm 181).

I set nets in the lower river prior to the suspected spawning season (December to January) to observe if burbot were still moving from Kootenay Lake into the river and tributaries to spawn. Nets were set at or near Deep Creek, Mission Creek, Kerr Lake outlet (rkm 196), Jerome Slough (rkm 191), Parker Creek (rkm 190), and Lucas Creek (rkm 182). Also, three to four nets were fished continuously in the vicinity of Ambush Rock (245 km). Nets were set with the aid of a Lowrance X16 graph recorder to help ensure the opening of the net was on the river bottom. Nets were checked every 24 to 72 h. I recorded the depth, substrate type (sand, gravel, cobble, or boulder), and the location (main channel, main channel border, outside bend, or inside bend) of the individual net sets.

Fish captured in the hoop nets were identified, enumerated, measured for total length (TL), weighed individually, and released. Some suckers and northern squawfish were used to rebait the net. Burbot sampled in 1994 were marked with a Passive Integrated Transponder (PIT) tag placed in the cheek muscle.

I also set eight hoop nets in the West Arm of Kootenay Lake to attempt to make a population estimate on a lake shelf locally known as the 'ling beds.' Nets were set from July 18-29, 1994 using the same methods as those employed on the river. This sampling was done in cooperation with fisheries staff of the British Columbia Ministry of Environment.

Search for Spawning Burbot

On February 5, 1994, five volunteers and I walked Boundary, Caribou, Parker, Smith, Deep, Ball, Parker, Mission, Trout, and Snow creeks and visually searched for burbot. Local anglers reported many burbot could be seen in these streams during February of the 1960s.

Burbot Fishing Ouestionnaire

I sought anecdotal information from local anglers on their past fishing success for burbot, locally called "ling." A questionnaire was handed out to members of the Kootenai Valley Sportsmens Club (Appendix A). The important questions included: Wuat was the most ling caught in one day?; When did you notice a decline in the ling fishing?; What was the best year for ling fishing?; What was the best time of year to fish for burbot?; and, When did you catch your last ling?

Burbot Telemetry

Adult burbot were captured with baited hoop nets and surgically implanted with sonic transmitters. Before surgical implantation, burbot were anesthetized in about 25 mg tricanmethanolsulfanate (MS-222)/L. The fish were then placed on a surgical table (Courtois 1981) and continuously bathed with water and anesthetic. Sonic transmitters were implanted according to the procedures of Summerfelt (1975), and size of transmitter was apportioned in accordance to the size of fish. Sonic transmitters of 420-day life expectancy were 60 mm in length, 16 mm in diameter, and weighed 8 g. Sex of most fish was determined during the surgery, and most fish were tagged with a PIT tag after completion of surgery. Burbot were held in a hatchery tank for at least three days for observation before release. All burbot were released in the location of original capture.

Seasonal habitat use by burbot were studied from November 24, 1993 through August 31, 1994. Four burbot used for telemetry were captured and released at Ambush Rock. Ambush Rock was an important location to burbot. Thus, the pool at Ambush Rock was mapped, depth contours plotted with the aid of a Lawrence X16 graph recorder, and a grid made at approximately 5-m intervals. When burbot were located by telemetry, their position was placed on the grid.

Electrofishing the Kootenai River

Population Estimates at the Hemlock Bar

Population estimates of rainbow trout and mountain whitefish within the Hemlock Bar reach of the Kootenai River were made in mid-September of 1993. The Hemlock Bar is about 2,970 m in length and is 29.41 hectares when discharge is at 113.3 m^3/s. Four nighttime trials were made using an 8-m boat mounted with a 230V DC Smith Root electroshocker which was adjusted to generate 5 amps. All rainbow trout, cutthroat trout, and mountain whitefish were anesthetized in MS-222, weighed, and measured for total length. Scale samples were taken from ten fish within each 10 mm class interval, the tip of the top caudal fin was clipped, and then fish were released. Population estimates were calculated using the Chapman modification of the Schnabel multiple census method (Ricker 1975). Confidence intervals were determined by assuming that the number of recaptures was a Poisson-distributed variable. Population estimates were made of two size groups of mountain whitefish; <160 mm and $\geq$ 160 mm. The smaller group were age 0 fish.

Relative Abundance and Trophic Structure

Researchers electrofished two reaches of the Kootenai River that were sampled by Partridge (1982); the Hemlock Bar (rkm 263) and Copeland (rkm 199), and a third surveyed reach (rkm 250). The objective was to identify species composition, relative abundance as catch per unit effort (CPUE), abundance by weight, and trophic structure. About 1 km of each reach was electrofished on both shorelines and the elapsed electrofishing time recorded. Fish were identified, enumerated, weighed, and released. Trophic level was assigned from food habit information in the literature (Wydoski and Whitney 1979; Simpson and Wallace 1982).

Sampling Tributary Streams

Rainbow trout and other species were sampled in 16 tributary streams of the Kootenai River and tributaries to Deep Creek with a model 11-A Smith Root backpack electroshocker (Figure 1). A single run sample was taken from a representative reach, which usually included the mouth (wadeable water) to about 200 m of most streams. There were several exceptions to this in that segments of some streams were nearly devoid of water during the drought of 1994. A core of five streams were selected in 1994 to estimate population densities and standing stocks. All fish were identified, enumerated, measured (TL), weighed, and released. Scales were taken from some trout for age analysis. CPUE was calculated by recording the elapsed time of electrofishing for each stream. The streams were measured and length and mean width of each stream reach was used to calculate surface area and relative one pass catch/100 m^2. The single pass samples were considered to represent a minimum estimate of density and used to compare to those of Partridge (1983).

Single pass electrofishing during October of 1993 was conducted on three tributary streams in British Columbia, Canada. This electrofishing was done with personnel from the British Columbia Ministry of Environment. The principle objective was to determine the presence or absence of juvenile burbot.

Angler Effort and Harvest

A stratified random creel survey was conducted from March 1, 1993 through February 28, 1994 to provide estimates of angling effort, catch, and harvest. We utilized an Idaho creel census program which provided all calculations and randomly choose a creel interview calendar (McArthur 1992).

The creel season was stratified by 13 periods to reduce variability and provide catch comparisons. The river was stratified into three segments and was non-uniformly sampled to reduce variability due to differences in access and fishing activity. Reach one extended from the Idaho-Montana border downstream to the Highway 95 bridge at Bonners Ferry, reach two was from the Highway 95 bridge to Copeland, and reach three was from Copeland to the Idaho-Canada border. I combined the data for all sections of the river. Creel data was collected by one creel clerk that interviewed anglers at access sites and occasionally by boat. Access sites were randomly chosen, as was the designation to creel river section one, two, or three. Four weekend days and eight week-days were worked each month at eight hours per day. Each day was divided into two randomly-chosen four-hour time periods. Information was collected from complete and incomplete angling trips.

Instantaneous angler counts were made periodically by jet boat to determine the fishing pressure for weekend and week-days. Counts were also made at randomly selected times between 0700 and 2000 h.

Creel survey data were expanded by river section and day type (weekend and week-days) to estimate harvest, catch, and effort (hours and angler-days) for each month. Monthly estimates for each river section were summed.

Zooplankton Sampling

I sampled the zooplankton community in the Kootenai River to provide a general reference to the species composition and temporal abundance of macrozooplankton genera. I collected three samples once each month from January to August 1994 at the Ambush Rock pool. Zooplankton were sampled with a 0.5-m diameter 130-micron plankton net calibrated by a Kahl scientific flow meter. Vertical hauls from a 15.24 m depth to the surface were made by manually raising the sampler at about 0.5 m/s. Samples were preserved in ethel alcohol. Ten subsamples from each sample were analyzed at the lab. Zooplankton were enumerated to genus, and sometimes species, using standard dilution and subsampling methods (Edmondson and Winberg 1971). Zooplankton counts were expanded to determine zooplankton densities.

RESULTS

Hoop Net Sampling

Total Catch

I fished hoop nets in the Kootenai River from October 1993 to April 1994 for a total of 887.8 net days. I caught a total of 118 fish, of which 46% were longnose sucker *Catostomus catostomus* and largescale sucker *C. macrocheilus,* 31% northern squawfish *Ptychocheilus oregonensis,* and 7% burbot, while the remainder was comprised of mountain whitefish, peamouth *Mylocheilus caurinus,* rainbow and bull trout, and three white sturgeon (Table 1). The total CPUE for all fish was 0.133 fish/net day, with longnose sucker as the highest at a CPUE of 0.053 fish/net-day. The total weight of my catch was 46.22 kg (Table 1).

Burbot

I caught a total of eight burbot, and an additional four more were caught during juvenile sturgeon sampling (Marcuson et al., in press). The CPUE for burbot from October 1993 through May 1994 was <.01 fish/net-day. These fish ranged from 349 to 670 mm (Figure 3) and weighed from 272 to 1,589 g (mean = 982 g). Seven burbot were caught at the base of Ambush Rock (rkm 244), while one fish was caught at the mouth of Deep Creek (rkm 241). The four additional burbot were captured at Smith Creek (rkm 174). Fish caught at Ambush Rock were caught at depths ranging from 10 to 20 m and in association with broken bedrock and

Table 1. Hoop net catch success by number, weight (kg), and catch per unit effort[a] (CPUE), Kootenai River, Idaho, October 1993 through May 1994.

Species	Number	Total weight (kg)	CPUE
White sturgeon	3	--	.003
Bull trout	3	4.49	.003
Rainbow trout	6	1.22	.006
Mountain whitefish	5	1.18	.006
Long nose sucker	47	7.98	.053
Large scale sucker	6	3.63	.006
Northern squawfish	6	19.73	.009
Burbot	8	7.48	.009
Brown bullhead	1	0.14	<.001
Yellow perch	3	0.23	.003
Peanose	1	0.14	<.001
Total	118	46.22	.133

[a] A unit of effort is a single 24-hour set.

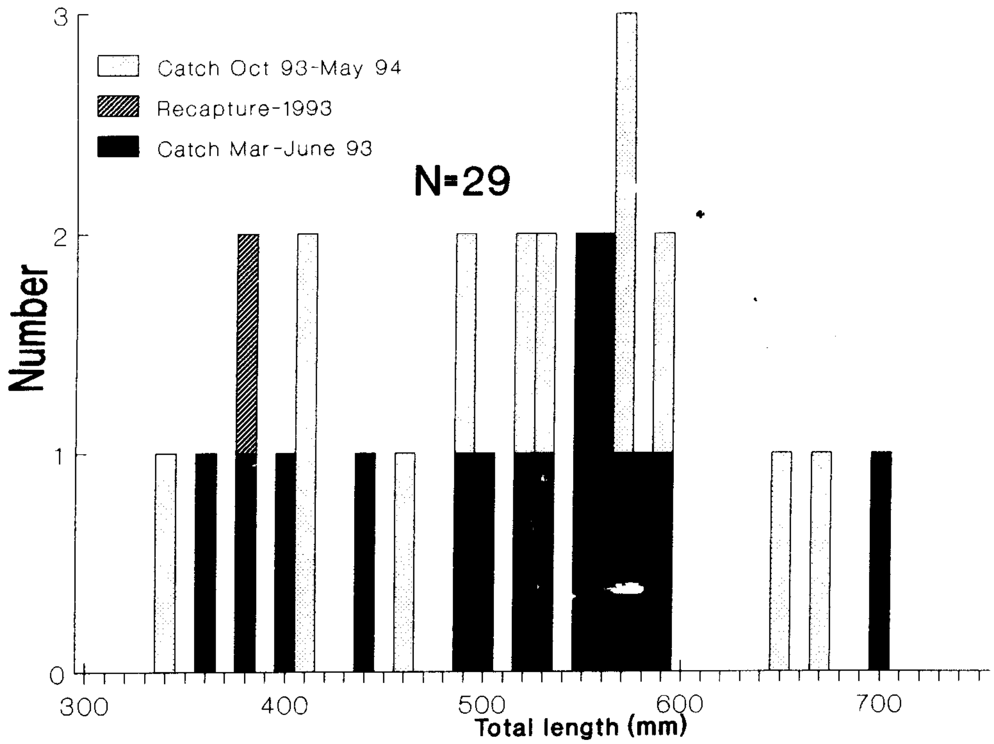

Figure 3. Length frequency distribution of burbot caught by baited hoop nets in the Kootenai River, Idaho, March through May 1993 and October 1993 through June 1994.

boulder substrate. The fish caught at Deep and Smith creeks were caught over sand substrate. All fish were captured at an outside bend within the thalweg.

No burbot were caught in early winter with 141.6 net days of effort. This netting was done in anticipation of intercepting burbot moving from Kootenay Lake to traditional spawning areas. Nor were any burbot caught with 80 net days of effort during July 1994 in the West Arm of Kootenay Lake, British Columbia.

Search for Spawning Burbot

No burbot were seen (February 5, 1994) in traditional spawning streams during the suspected spawning season.

Burbot Fishing Questionnaire

Twelve anglers filled out the questionnaire, of which ten actually fished for burbot in the Kootenai River. In general, burbot fishing success was best in the late 1960s and early 1970s and began a rapid decline in the late 1970s and early 1980s. The most ling caught in a day by a single angler was 48. About 25% of the anglers used set lines, but none reported using a spear. Anglers reported January and February to be the best months to fish for burbot.

Burbot Telemetry

Movement

Six burbot were implanted with sonic transmitters (Table 2), released at the capture site, and located a total of 69 times from November 1993 through August 1994. Burbot 96 was located only once, at rkm 177, while 446 was located 21 times from rkm 244 to 246. Most burbot stayed in close proximity to the release site (Appendices B, C, D, E, F, and G). However, after release in March at Ambush Rock (rkm 244), burbot 455 traveled 128 km to Kootenay Lake (rkm 115.5) where it was last located in July 1994. Burbot 96 has not been located since release on July 7, 1994.

Habitat

Burbot were seldom located in less than 6 m of depth, but depths ranged from 1 to 19.2 m with an unweighted mean depth of 9.9 m. Substrate could not be identified at all locations, but accounts from diving indicate that most locations were comprised of silt or sand (Pat Marcuson, IDFG, personal

Table 2. Summary of sonic telemetry data and physical characteristics of six burbot in the Kootenai River, Idaho, and Kootenay Lake, British Columbia, Canada.

Sonic code	Date implanted	Total length (mm)	Weight (g)	PIT number	Sex	Last date located
446	17 Nov 93	650	1,600	None	M	15 Feb 94
374	10 Dec 93	670	1,600	None	F	8 Mar 94
455	4 Mar 94	590	1,135	7F7DO132A	F[a]	2 Jul 94
365	11 Mar 94	574	945	7F7D0034A		9 Aug 94
383	29 Jun 94	527	1,078	7FDOD7C76	F[b]	7 Sep 94
96	29 Jun 94	560	1,135	7F7DOB684C	M	7 Jul 94

[a] Unspawned

[b] Immature Ova

communication). The Ambush Rock location is a rock ledge, and at a discharge of about 566.7 m^3/s, has a pool depth of about 21.3 m.

Four burbot used for telemetry were captured and released at Ambush Rock. When burbot were located by telemetry at Ambush Rock, their location was placed on a map with a 5-m grid interval (Figure 4). Burbot were usually located in the thalweg and at the base of an underwater rock ledge.

Visual contacts were made with burbot 446 and 374. In each case, burbot were in close proximity to cover; aquatic vegetation, or large woody debris. Nose velocities were measured twice on 446; 1.83 cm/sec and 2.24 cm/sec. Current velocity in the vicinity of 446 was 2.52 to 3.21 cm/s, and greater in other locations of the river.

24-Hour Telemetry and Spawning Season

Burbot 446 remained at Ambush Rock from release (November 24, 1993) until January 26, 1994 when it moved about 200 m upstream to a shallower reach. Suspecting a move to a spawning location, I monitored this fish over a 48-h period through the evenings from January 27 to 29. I recorded no evidence of spawning, but characteristically the fish moved from a depth of about 10.1 m at the onset of dark to 7.6 m, and swam this contour until 0230 when it returned to deeper water. Burbot 374 could not be located from January 7 through February 15, 1994, but internal examination of this fish on March 10, 1994 indicated it had not spawned. Capture of burbot 455 in early March and internal examination prior to implanting a transmitter indicated it had not spawned.

Mortality

Two burbot were found dead about four months after implanting sonic transmitters; 446 and 374. In either case, the exact cause of death is not known, but 374 probably died from post-implant complications. Burbot 446 was apparently trapped in an ice dam. After visual contact was made in early February, cold weather and ice trapped this fish in shallow water. It was found dead on February 15, 1994 after the ice melted.

Kootenai River Electrofishing

Population Estimates at the Hemlock Bar

Rainbow Trout-Electrofishing accounted for a total catch of 27 rainbow trout, of which two were recaptures. These fish ranged from 176 to 414 mm (mean=250) (Figure 5), ranged from 50 to 680 g in weight (mean=203), and had a K of 1.15. Back-calculated total lengths of rainbow trout were 68, 160, 234,

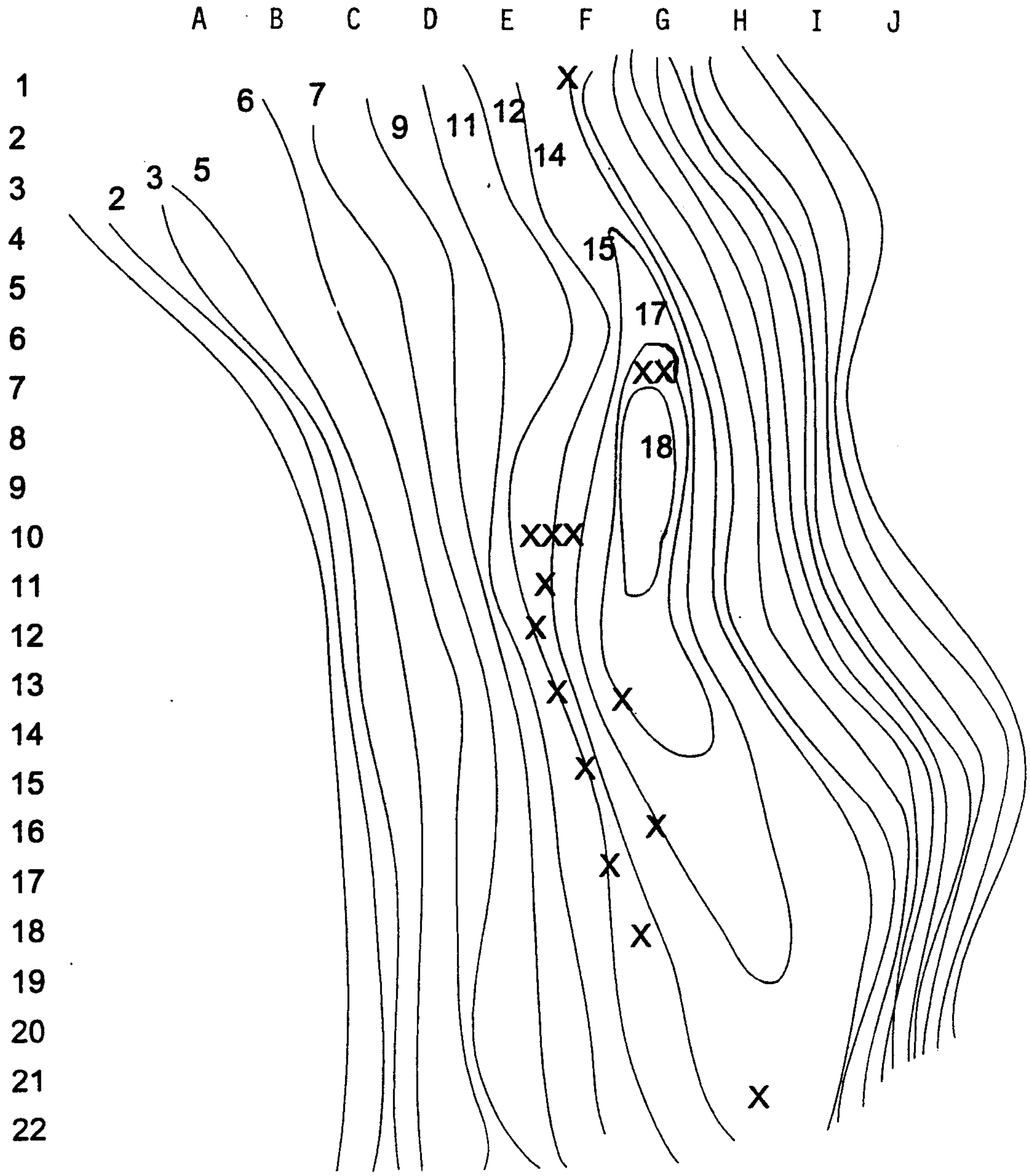

Figure 4. Contour map of the pool at the base of Ambush Rock, transects, and the location (X) of four burbot as detected with sonic telemetry, November 1993 through May 1994, Kootenai River.

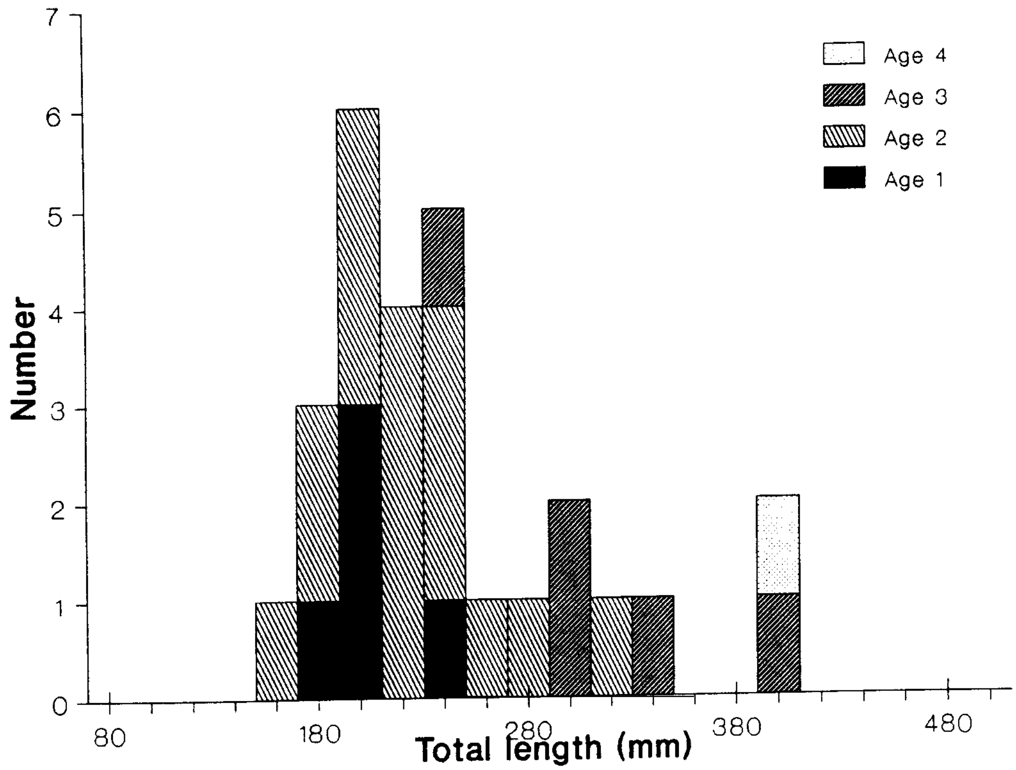

Figure 5. Length frequency distribution of rainbow trout sampled by electrofishing the Hemlock Bar of the Kootenai River, 1993.

324, and 414 mm for ages 1-5 (Appendix H). The estimated population of rainbow trout, using the Hemlock Bar as part of their home range and based on the recapture of 2 fish, was 98 fish (CI = 78-118), 3 rainbow trout/hectare, a standing stock of 0.67 kg/hectare, and 10.1 trout/305 m (1,000 feet).

Cutthroat Trout-Electrofishing accounted for a total catch of only two cutthroat trout; they were 280 mm at 250 g, and 336 mm at 341 g.

Mountain Whitefish-Sampling the Hemlock Bar resulted in a total catch of 1,582 mountain whitefish, of which 1,373 were > 160 mm, or age 1 and older. Of this total, 186 were recaptures. A total of 209 age 0 mountain whitefish were caught and marked, but none were recaptured. Mountain whitefish ranged in total length from 80 to 500 mm and weighed from 5 to 1,035 g with an average K factor of 0.91 (Figure 6). Back-calculated total lengths of mountain whitefish were 91, 123, 140, 174, 199, 250, and 300 mm for ages 1-7 (Appendix I). The estimated population of mountain whitefish ≥ 160 mm using the Hemlock Bar as part of their home range was 3,440 fish (CI= 3,325 - 3,555), 117/hectare, a standing stock of 21.05 kg/hectare, or 353 mountain whitefish/305 m (1,000 feet).

Relative Abundance and Trophic Structure

Electrofishing captured nine species of fish from the Hemlock Bar and rkm 250 (two canyon reaches), and six at Porthill (flood plain reach) (Table 3). Total catch ranged from 105 fish weighing 10.58 kg at Porthill to 194 fish at 56.99 kg at Hemlock Bar (Table 3). Mountain whitefish were the most abundant fish at the Hemlock Bar and rkm 250 at 179 and 226 fish/h, respectively. Peamouth were the most abundant fish at Porthill at 126/h (Table 3).

Trophic structure was comprised primarily of omnivores at the canyon reaches averaging 75% of the biomass, while the majority (50%) of the biomass at Porthill was comprised of insectivores (Figure 7). Piscivores contributed an average of 4% of the total biomass at the canyon reaches and 16% at Porthill (Figure 7).

Samplinq Tributary Streams

Stream Dimensions

We sampled 16 tributary streams with single pass electrofishing during the 1994 sampling period (Table 4). The length of sampled reaches ranged from 88 m for Trail Creek (the only length of flowing water in Trail Creek) to 666 m for Cow Creek (Table 4). Surface area for sampled reaches ranged from 0.020 hectares for Twenty-Mile Creek to 0.485 hectares for Smith Creek.

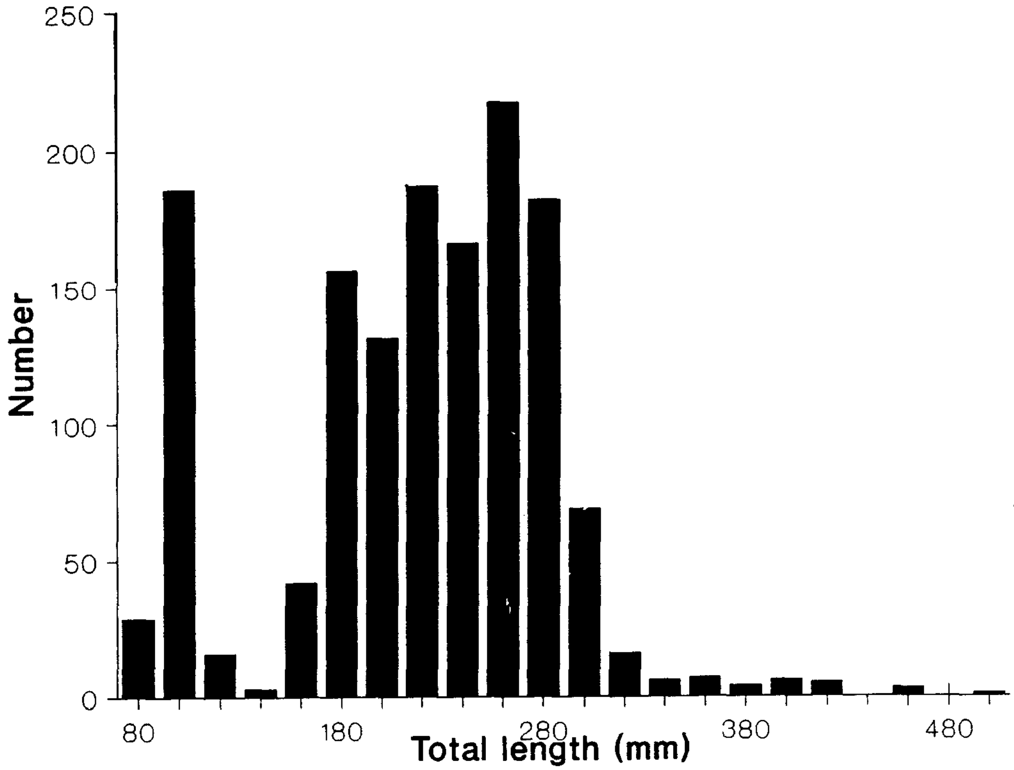

Figure 6. Length frequency distribution of mountain whitefish sampled by electrofishing Hemlock Bar of the Kootenai River, 1993.

Table 3. Single pass electrofishing catch from three river reaches in the Kootenai River, August 1994, and trophic level for each species: Ins - insectivore, Pla - planktivore, Omn - omnivore, Herb - herbivore, and Ins-Pisc - insectivore piscivore.

		Hemlock Bar			RKM 250			Port Hill		
Species	Trophic level	N	CPE	Weight (kg)	N	CPE	Weigh t	N	CPE	Weight (kg)
Mountain whitefish	Ins	77	179	10.61	65	152	9.33	0	--	--
Rainbow trout	Ins	3	7	0.63	1	2	.23	2	5	.65
Kokanee	Pla	2	5	0.20	2	5	.25	1	2	.25
Chiselmouth	Herb	7	16	0.91	1	2	.23	0	--	--
Peamouth	Ins	3	7	0.25	3	7	.10	546	126	4.68
Longnose sucker	Omn	4	9	1.90	26	61	9.9	0	--	--
Largescale sucker	Omn	54	126	39.14	51	119	28.50	8	17	3.20
Redside shiner	Ins	27	63	.23	5	12	0.09	23	54	.23
Squawfish	Ins-Pisc	17	40	2.10	5	12	0.96	17	40	1.70
Total		194		56.99	161			105		10.58

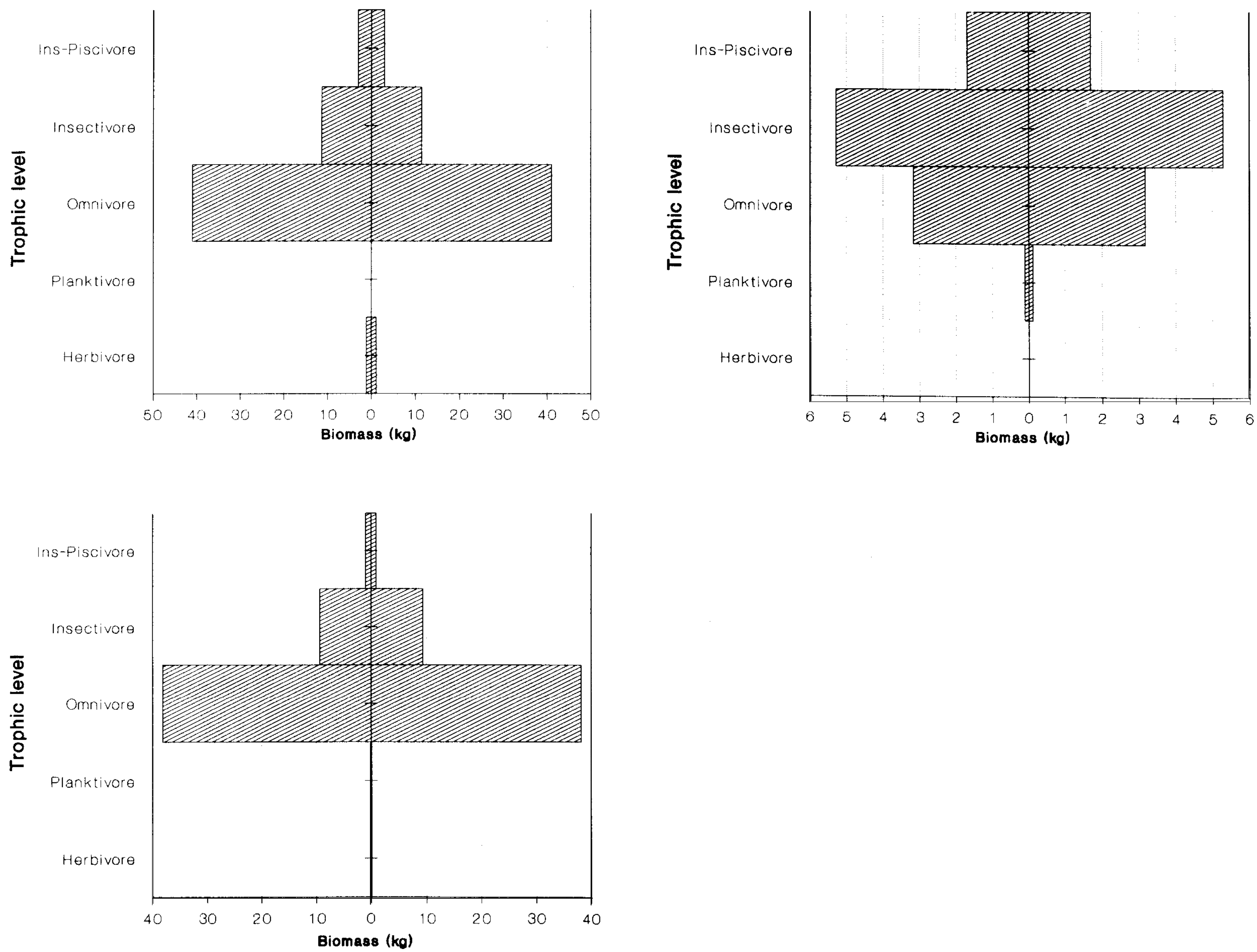

Figure 7. Trophic structure of the fish community of three reaches of the Kootenai River. The top left figure is the Hemlock Bar community, top right is the Porthill community, and the lower figure is rkm 250. Samples taken by electrofishing, July 1994.

Table 4. Length, mean width, and area of tributaries to the Kootenai River, Idaho, that were sampled July-September 1994.

Stream	Section	Length (m)	Mean width (m)	Area (m^2)	Area (hectares)
Debt Creek	A[a]	224	1.4	318	0.03
Caboose Creek	A	256	2.4	622	0.06
Curly Creek	A	240	3.8	920	0.09
Cow Creek	A	665	2.0	1,365	0.13
Dodge Creek	A	140	2.7	391	0.03
Moyie river	A	353	--	--	--
Trail Creek	A	374	2.7	1,043	0.10
Falls Creek	A	571	7.3	4,189	0.41
	B[a]	125	6.1	764	0.07
Ruby Creek	A	208	3.8	806	0.08
	B	360	5.3	1,908	0.19
Mission Creek	A	240	4.4	1,056	0.10
Boulder Creek	A	526	6.5	3,432	0.34
Deep Creek	A[a]	101	11.1	1,126	0.12
	B	235	--	--	--
Twenty Mile	A	87	2.2	196	0.02
Long Canyon	A[a]	67	27.5	1,845	0.18
Snow Creek	A[a]	200	7.3	1,482	0.14

[a]In addition to single run CPUE population estimates were made within this reach.

Stream Electrofishing Catch

We sampled eight species of fish including rainbow trout, cutthroat trout, bull trout, longnose dace *Rhinichthys cataractae,* redside shiner *Richardsonius balteatus,* northern squawfish, slimy sculpin *Cottus cognatus,* torrent sculpin *C. rhotheus,* and mountain whitefish (Appendix J). Total catch ranged from 6 fish in Caboose Creek to 568 in Trail Creek (Appendix J). Diversity ranged from two species found in Debt Creek to seven found in Fall Creek.

Trout Abundance

Trout were caught in all streams, with the exception of the Moyie River, but minimum densities within natural stream reaches ranged from less than 0.01 trout/100 m^2 for Cow Creek to 76 trout/100 m^2 in Twenty-Mile Creek (Table 5). Rainbow trout were the most abundant salmonid, ranging as high as 66 trout/100 m^2 for Twenty-Mile Creek. Cutthroat trout were sampled only in Caboose Creek at .2 trout/100 m^2. Scale analysis indicated most trout caught were age 0 and 1 (Figure 8). Ruby Creek is used as a typical example of the length frequency distribution of trout. Whereas fish in Debt and Caboose creeks were of 'stunted' populations up to age 3. No burbot were collected in any of the tributaries surveyed.

Fish Population Estimates and Standing Stocks

Estimated density of trout ranged from 189/hectare in Long Canyon to 9,750/hectare in Snow Creek (Table 6). Rainbow trout were the most abundant trout ranging up to 7,329/hectare in Snow Creek. Bull trout were only found in Long Canyon Creek at an estimated density of 11/hectare. Standing stock of rainbow trout ranged up to 13.1 kg/hectare (Table 6).

British Columbia Tributaries to the Kootenai River

Summit, Goat, and Corn creeks were sampled with single pass backpack electroshocking on October 14, 1993. Electrofishing Summit Creek for 45 minutes resulted in the catch of 11 rainbow trout, 1 brook trout, 24 longnose dace, 12 sculpins, 2 mountain whitefish, and 1 squawfish. Electrofishing Corn Creek for 32 m provided a catch of 46 rainbow trout, 2 brook trout, 10 longnose dace, 1 sculpin, 1 mountain whitefish, 1 longnose sucker, and 1 squawfish. Electrofishing in Goat Creek for 55 minutes yielded a juvenile burbot 350 mm in length and weighing about 341 g. Enumeration of rainbow trout was discontinued after well over 100 yearling fish were captured and many others were seen but could not be captured because of swift current and/or deep water.

Table 5. Single run electrofishing catch (per 100 m^2) in natural stream reaches of 16 tributaries of the Kootenai River, Idaho, July-September 1994. The catch per 1,000 m is subtended.

Stream		Mountain whitefish	Rainbow trout	Cutthroat trout	Brook trout	Bull trout	Squawfish	Sucker	Longnose dace	Bedside shiner	Sculpin
Debt Creek		0	3.5 (49.0)	0	0	0	0	0	0	0	0.3 (4.5)
Caboose Creek		0	.2 (3.9)	.2 (3.9)	05 (11.7)	0	0	0	0	0	0.3 (4.3)
Curly Creek		.3 (12.4)	0	1.2 (45.6)	0	0	0	0	2.7 (103.8)	0	.1 (4.2)
Cow Creek		0	8.0 (16.5)	0	<.1 (1.5)	0	0	0	0	0	0
Dodge Creek		0	11.5 (319.4)	0	2.3 (63.9)	0	0	0	0	0	0
Moyie River		0	0	0	0	0	(14.1)	0	-- (96.2)	-- (19.8)	-- 50.9
Trail Creek		0	44.0 (1,226.9)	0 0	.4 (112.3)	0	.4 (10.7)	0	3.1 (85.5)	0	3.0 (82.9)
Falls Creek	A	<.1 (1.7)	4.1 (299.2)	0	.4 (29.7	0	<.1 (1.7)	0	1.7 (122.5)	.1 (7.0)	.8 (57.7)
	B	.5 (31.9)	17.5 (1,069.4)	0	6.0 (367.1)	0	0	0	5.2 (319.2)	.7 (39.9)	4.1 (247.4)
Ruby Creek	A	.1 (4.8)	23.1 (890.8)	0	5.8 (225.1)	0	0	.2 (9.6)	9.3 (359.2)	0	0
	B	.4 (22.2)	21.3 (1,130.6)	0	1.4 (72.2)	0	0	0	3.9 (208.3)	0	0
Mission Creek		0	0	4.1 (179.2)	12.1 (533.3)	0	0	0	0	0	1.6 (70.8)
Boulder Creek		.3 (17.1)	3.9 (252.6)	0	l (9.5)	0	0	0	1.7 (110.2)	0	1.2 (76.0)
Deep Creek	A	0	4.3 (472.9)	0	.3 (29.6)	0	0	0	5.3 (591.1)	0	4.7 (522.2)
	B	-- (21.3)	(17.0	0	0	0	--	--	--	--	--
Twenty Mile		0	65.8 (1,474.3)	0	10.7 (240.0)	0	0	0	0	0	0

Table 5. Continued.

Stream	Mountain whitefish	Rainbow trout	Cutthroat trout	Brook trout	Bull trout	Squaw fish	Sucker	Longnose dace	Bedside shiner	Sculpin
Long Canyon	.3 (89.4)	.6 (163.9)	0	.2 (59.0)	<.1 (14.9)	0	0	.2 (59.6)	0	.6 (163.9)
Snow Creek	0	6.7 (493.5)	0	1.0 (74.8)	0	0	0	0	0	0

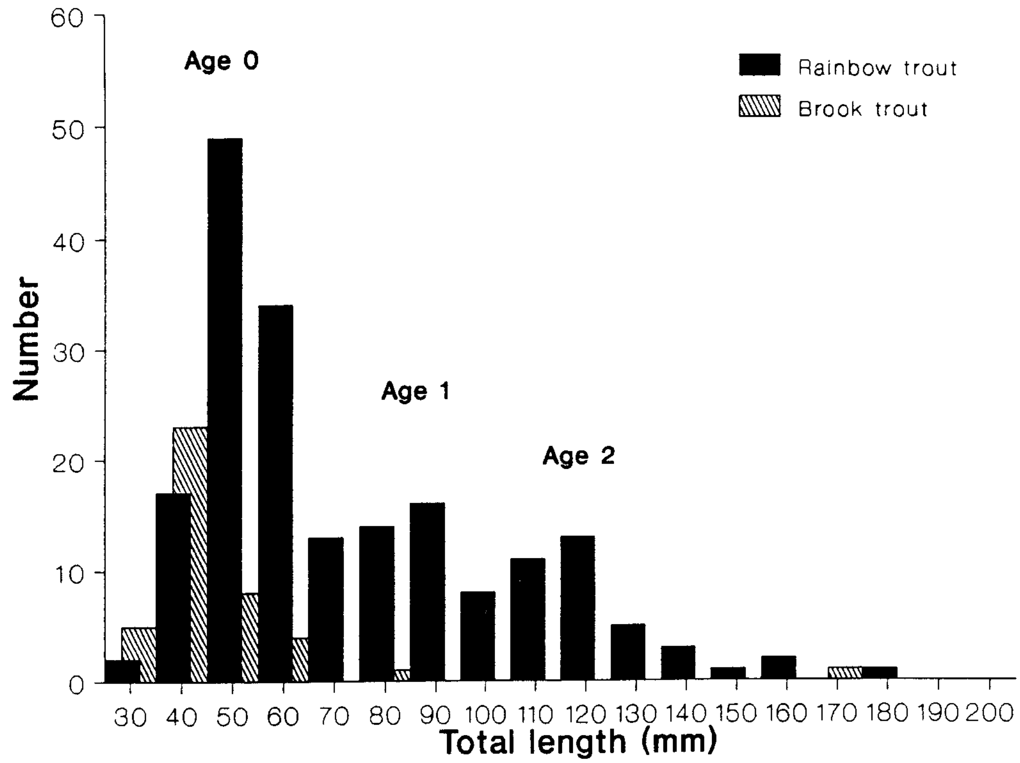

Figure 8. Length frequency distribution of rainbow trout and brook trout sampled by electrofishing Ruby Creek, Idaho, 1994. Ages were determined by scale analysis of subsamples from populations and subjectively fitted to peaks of the distributions.

Table 6. Catch, recapture, population estimates, density, and estimates of standing stocks of species of fish from five streams in the Kootenai River drainage. Catches were made by backpack electrofishing, July - September 1994.

Stream	Species	N	C.I. (95%)	Density (N/ha)	Standing stock (Kg/ha)
Deep Creek	Rainbow trout	262	230-294	2,063	2.5
	Brook trout	3	1-9	24	<.1
	Longnose dace	531	486-576	4,181	12.5
	Sculpin	280	247-313	2,205	6.6
Snow Creek	Rainbow trout	766	712-820	5,176	13.1
	Brook trout	59	44-74	399	2.1
Falls Creek	Rainbow trout	577	411-603	7,329	11.6
	Brook trout	184	157-211	2,421	5.3
	Mountain whitefish	8	3-16	105	.7
	Longnose dace	113	92-134	1,487	3.0
	Sculpin	128	106-150	1,684	6.7
Long Canyon Creek	Rainbow trout	28	17-39	151	2.6
	Brook trout	5	2-12	27	.4
	Bull trout	2	2-7	11	.2
	Mountain whitefish				
	Longnose dace	73	56-90	395	1.2
	Sculpin	147	123-171	795	1.6
Debt Creek	Rainbow trout	25	16-37	781	10.5
	Brook trout	2			

Sport Fishery

Total Catch and Effort

Creel clerks interviewed 168 anglers during the complete creel year (97% were residents) with a total of 213 instantaneous angler counts. Fifty of the anglers had completed their fishing trip for an average trip length of 2.57 hours. Total estimated effort was 15,252 hours (95% C.I.; ± 4,136 hours) for 5,935 angler days. About 72% of the anglers were interviewed between Copeland and Bonners Ferry. Most of those anglers were between Deep Creek and Ambush Rock. Only four anglers were observed fishing downstream of Copeland during instantaneous counts; none were interviewed. Bank anglers comprised 62% of the fisherman while the remainder fished from boats.

Anglers caught a total of about 6,464 fish (± 3,414) of which 4,189 (± 3,266) fish were kept (Table 7; Figure 9). Whitefish were the most abundant fish in the harvest with 1,168 (± 923) being taken, while rainbow trout were second with a harvest of 1,040 (± 905) (Table 7). An additional 156 (± 158) cutthroat trout were harvested, as well as 301 (± 582) rainbow x cutthroat (Table 7). No burbot or bull trout were seen in the creel, but several bull trout were reported to have been creeled. One white sturgeon was caught and released and a second reported. Harvest of non-sport fish included 648 (± 1,166) northern squawfish, 656 (± 1,169) peamouth, and 215 (± 506) suckers (Table 7). No kokanee were seen during the creel survey, but several were reported.

Average estimated catch rates for the creel survey were .03 mountain whitefish/h, .02 rainbow trout/h, .01 cutthroat trout/h, and about .01 suckers/h (Table 8). As expected, the catch success of anglers targeting specific species was higher than general angling; anglers fishing for rainbow trout caught .16/h, mountain whitefish anglers caught .58/h, and white sturgeon anglers caught .02/h.

Mean lengths of fish in the creel were 292 mm for rainbow trout, 347 mm for cutthroat trout, 296 mm for mountain whitefish, 269 mm for rainbow x cutthroat trout, 375 mm for suckers, 457 northern squawfish, and 226 mm for peamouth.

Anglers were asked two management-oriented questions. Are you fishing primarily to fish or for another reason? The response was 85%- were fishing to fish. The second was: Do you feel there is sufficient access to the river? About 69% of the anglers responded yes.

Zooplankton Samplinq

Zooplankton sampling gear captured five genera of zooplankton from the Kootenai River from January to August 1994 (Figure 10; Appendix L). In general, there was a paucity of zooplankton in the samples even when they were at peak density ranging from <0.01\L in July to 3.7\L in May. Cyclops were the most

Table 7. Estimated effort and harvest of fish by period (95% confidence intervals are subtended), Kootenai River, Idaho, 1993-1994.

Period	Effort	Total catch	Total harvest	Estimated fish harvested							
				Rainbow	Whitefish	Cutthroat	Squawfish	Hybrid trout	White sturgeon	Suckers	Peamouth
Mar 1-Mar 30	307	276	276	0	61	0	0	0	0	215	0
Mar 31-Apr 29	1,082	412	412	0	412	0	0	0	0	0	0
Apr 30-May 29	989	168	148	16	8	0	58	0	0	0	66
May 30-Jun 28	1,476	1,771	1,476	0	0	0	590	295	0	0	590
Jun 29-Jul 28	4,814	1,770	1,364	684	572	105	0	0	0	0	0
Jul 29-Aug 27	4,283	1,540	0	0	0	0	0	0	0	0	0
Aug 28-Sep 26	373	66	66	33	0	33	0	0	0	0	0
Sep 27-Oct 26	359	0	0	0	0	0	0	0	0	0	0
Oct 27-Nov 25	0	0	0	0	0	0	0	0	0	0	0
Nov 26-Dec 25	158	123	123	35	70	18	0	0	0	0	0
Dec 26-Jan 24	281	76	76	51	18	0	0	6	0	0	0
Jan 25-Feb 23	522	156	142	115	27	0	0	0	0	0	0
Feb 24-Feb 28	608	106	106	106	0	0	0	0	0	0	0
TOTALS	15,252	6,464	4,189	1,040	1,168	156	648	301	0	215	656
		(3,414)	(3,266)	(905)	(923)	(158)	(1,116)	(582)		(506)	(1,169)

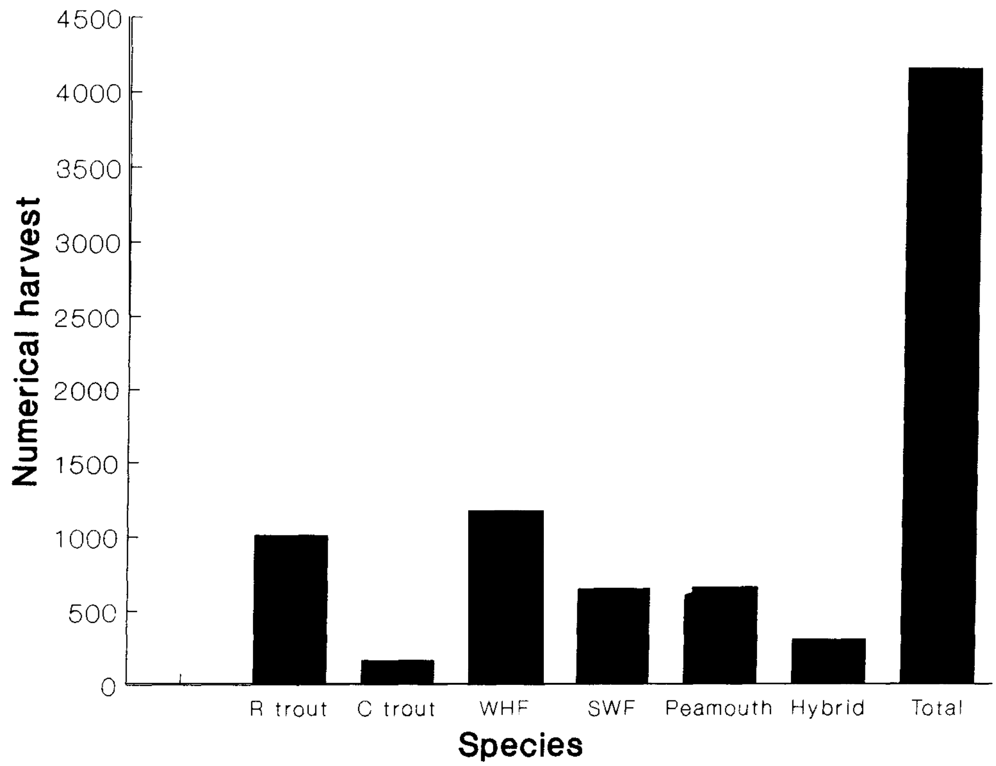

Figure 9. Harvest of six species of fish and their total from the Kootenai River, March 1, 1993 through February 29, 1994. Abbreviations are: rainbow trout - R trout; cutthroat trout - C trout; mountain whitefish - WHF; northern squawfish - SWF; rainbow x cutthroat trout - Hybrid.

Table 8. Estimated catch (C) and harvest (H) rates (catch/h' for anglers fishing the Kootenai River, Idaho, March 1, 1993 - February 28, 1994.

		Fish species															
		Whitefish		Suckers		Rainbow		Cutthroat		Sturgeon		Bull trout		Burbot		Largemouth bass	
Interval	Day type	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H
1	Weekday	0.20	0.20	0.70	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	Weekday	0.38	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.03	0.03	0.00	0.00	0.05	0.05	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Weekday	0.06	0.06	0.00	0.00	0.17	0.17	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.30	0.30	0.00	0.00	0.08	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.26	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.09	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Weekday	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Weekday	0.44	0.44	0.00	0.00	0.22	0.22	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 8. Continued.

		Fish species															
		Whitefish		Suckers		Rainbow		Cutthroat		Sturgeon		Bull trout		Burbot		Largemouth bass	
Interval	Day type	C	H	C	H	C	H	C	H	C	H	C	H	C	H	C	H
11	Weekday	0.08	0.08	0.00	0.00	0.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.44	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	Weekday	0.23	0.15	0.00	0.00	0.23	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.22	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Weeday	0.00	0.00	0.00	0.00	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Weekend	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weekday Average		0.03	0.03	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weekend Average		0.02	0.01	0.01	0.00	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Season Average		0.03	0.03	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

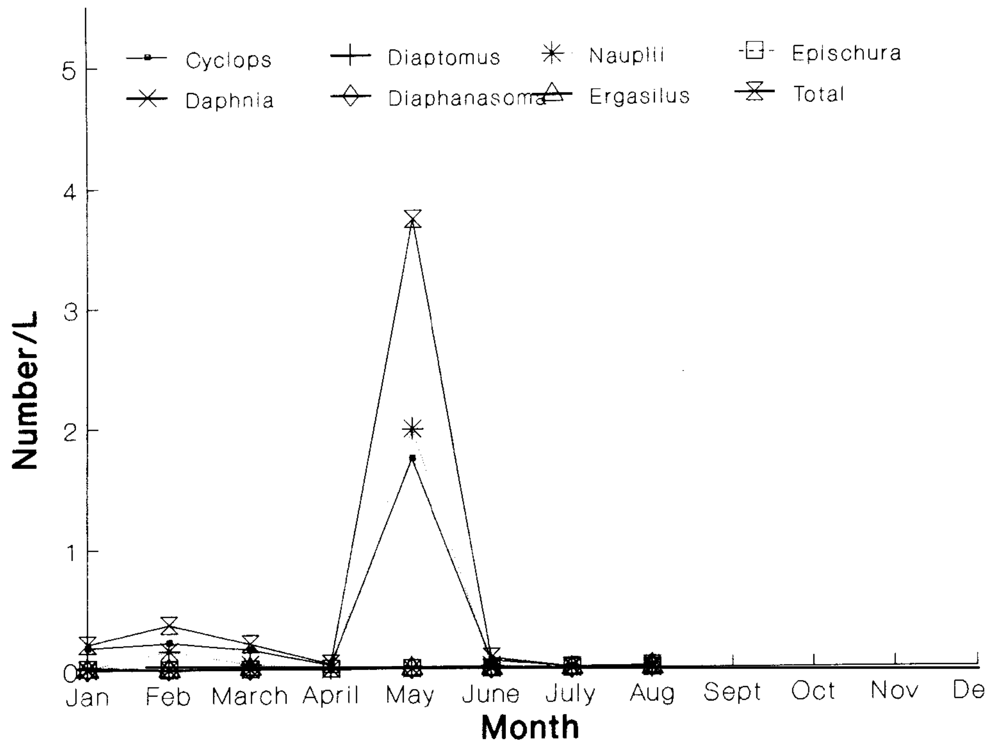

Figure 10. Temporal distribution of zooplankton sampled at mid day by a verticle haul from the Kootenai River, 1994.

abundant zooplankton genera ranging from <0.01\L in July to 1.7\L in May (Figure 10; Appendix L). All other genera were rare, and in some circumstances, only one individual was collected.

DISCUSSION

Burbot Population Status 1993-1994

Burbot in the Idaho reach of the Kootenai River are at a very low density, and natural reproduction remains unverified. I caught only eight burbot from October 1993 to May 1994 with 887.8 net days of effort (CPUE of 0.009/net day), while an additional four fish were captured during juvenile sturgeon sampling in June 1994 (Figure 3). Only 17 burbot were caught in 1993. Although it is difficult to distinguish strong and weak year classes, the presence of several year classes and juvenile fish indicates natural reproduction does occur in the drainage. Burbot are known to spawn in Fisher Creek, Montana (Don Skarr, Montana Department of Fish, Wildlife and Parks, personal communication), and in autumn of 1993, a juvenile was captured in the Goat River of British Columbia, but electrofishing efforts in tributary streams in Idaho failed to document any burbot. What remains to be answered is why spawning habitat in Montana was used for burbot reproduction but it was not in Idaho.

Burbot Telemetry

Habitat use by burbot in the Idaho reach of the Kootenai River were based on the sonic telemetry of only six fish. This limits the interpretation of the data because observations are indicative of the behavior of a few fish rather than a population. This can only be rectified with more burbot transmittered.

Preliminary information indicates burbot use the thalweg of the Kootenai River during daylight. Most contact fish were in the deepest portion of the river, an average depth of 9.9 m. The best evidence of this is the location of burbot in the Ambush Rock pool (Figure 3). Three burbot inhabited this pool, and when monitored, they were located in the deepest point of the river. Burbot 446 moved into shallower water only during darkness. Breeser et al. (1988) radio-tracked burbot in the Tanana River, Alaska and found they preferred the main river channel during all periods of the year. The preference for the deep channels may be due to their weak swimming ability and low tolerance of fast current (Jones et al. 1974). When I made visual contact with burbot 446 and 374, they were in very slow current (2.04 cm/s) and in close proximity to cover. When the river discharge was ramping up, about 396.8 m^3s, burbot 365 moved out of the pool at Ambush Rock through swift current to calm shallow water (4 m) but no further. This was a distance of only 2 km. Partridge (1983) tagged 34 burbot; several moved upstream of their original tagging site, but none moved above the Ambush Rock site to swift riverine habitat.

Burbot did not demonstrate a substrate preference. McPhail (1994) reviewed burbot literature but did not find a preference for substrate type. Adult burbot were strongly associated with the bottom of lakes and it appeared to be temperature driven. Edsall et al. (1993) found burbot at depths of 23 to 36 meters, with temperatures of 8°C to 10°C in Lake Michigan.

Telemetry of six burbot from November 1993 through the traditional spawning season in 1994 provided no evidence of spawning. Burbot are winter spawners and often spawn under the ice in January through March (Becker 1983). Examination of gonads of three indicated none had spawned. Burbot spawn at about 1.5°C, or near freezing temperatures (Becker 1983 and McKay 1963).

No evidence was collected which would define whether burbot are residents, emigrants from Lake Koocanusa, or from Kootenay Lake. Researchers in Montana will PIT tag burbot they capture, which may help determine movement if they are recaptured in Idaho. Sonic telemetry of a burbot now in Kootenay Lake may provide evidence of movement of burbot between the international boundaries.

Instream flow studies are scheduled for the Kootenai River in Idaho for the 1995 field season. I also plan on implanting sonic transmitters into more burbot in the autumn of **1994** and carry this work through 1995. The sonic telemetry will provide more information as to habitat preferences and possible spawning' locations of burbot in Idaho. These studies and development of habitat suitability curves will help illustrate habitat needs for all life stages of burbot.

Physical and Biological Variables That May Affect Burbot

Creation of reservoirs is followed by a repeated pattern in that there is an increase in the density of burbot in the reservoir but a decline in the population below (McPhail 1994). This could be due to physical and biological changes that are poorly understood in respect to burbot. The possible consequences of post-dam changes in winter flow and temperatures of the Kootenai River to burbot were considered in the 1993 Annual Report (Paragamian 1994). In this report, I propose the hypothetical consequence to a burbot egg spawned at the mouth of Deep Creek in March and a possible link to Kootenay Lake and lake productivity. Post- and pre-dam river temperatures, discharge, and average current velocities were incorporated with egg hatching time at given temperatures to determine hatching location. For example, burbot eggs have a large oil globule and are semi-buoyant to buoyant (Miller 1970), thus they could be expected to drift in the rivers water column (Miller 1970). Optimum incubation temperature lies between 1.0°C and 7.0°C (Jager et al. 1981). Pre-dam conditions provided colder March temperatures and slower velocities. At a temperature of about 2°C to 3°C, an egg would hatch in about 42 days (Miller 1970) and be in Kootenay Lake. At about 6.1°C, the approximate present March temperature of the river, eggs would hatch in 20 days (Bjornn 1940), and at prevailing river velocities with 187 m^3\s, the egg would take only 5 days to reach the lake; a distance of 120 km. With either scenario, the burbot egg is in the lake at hatching, and survival is subject to dictation by the lake ecosystem. The productivity of Kootenay Lake has declined substantially since construction of Libby Dam (Dailey et al. 1981), and populations of fish and mysid shrimp have declined. Larval burbot are pelagic (Clady 1976; Ghan and Sprules 1991) and their first food is zooplankton (Ghan and Sprules 1991; Ryder and Pesendorfer 1992), although Vatcha (1990) suggested the first food may be phytoplankton. Zooplankton densities in Kootenay Lake have also diminished making prospects for larval fish survival lower than pre-dam years. Although this case is hypothetical, I believe lake productivity has Lffected burbot as it has other fish populations. Especially since larval burbot would require an immediate food source when densities are naturally low in late winter. Additional discussion of the productivity of the Kootenai system is presented in this report. Research on spawning locations, the distribution of adults in the lake, early life history and hypothesis testing of physical and biological variables is recommended.

Replication of Burbot Samplinq

Inventory of burbot to detect changes in the stock status will require uniform replication of this study. This stock is at a very low density and could only be captured at one site, Ambush Rock. Thus, sampling efforts should be directed at Ambush Rock, but also other traditional sites (Partridge and Jeppson, IDFG, personnel communication) like Boundary Creek, Smith Creek, Deep Creek, and Shorty's Island to detect improvement in the density. Sampling should take place from March to May, the best time of the year to capture burbot in the Kootenai River with eight to ten baited hoop nets of 61 or 91 cm diameter and checked every 24 to 72 h. Three to five nets should be fished in the thalweg at Ambush Rock, and the remaining nets fished at two or more of the additional locations. Sampling at Ambush Rock with three to five baited hoop nets during March to May 1993 captured 16 burbot with 320 net days of effort, a CPUE of .05; while 262 net days of effort in 1994 captured seven fish at .027 CPUE. Sampling with 56 and 54 net days in 1993 and 1994, respectively, at the additional locations captured no burbot. Burbot were also captured in the Kootenai River in the Montana reach below Kootenai Falls at 0.13 CPUE in 1992 and 0.07 CPUE in 1993 (Don Skarr, Montana Department of Fish, Wildlife, and Parks, personal communication).

Kootenai River Productivity

Construction of Libby Dam is responsible for the loss of nutrients in the lower Kootenai River and is responsible for lower primary production (Snyder and Minshall 1994), and I have shown low zooplankton densities, slower growth of some fish, lower standing stocks, reduced carrying capacity, and changes in trophic structure of the fish community. Over the past 30 years, the Kootenai system has reversed from one of excess nutrients to that of nutrient depravation (Northcote 1973; Daley et al. 1981). Recent studies have shown Lake Koocanusa to be a nutrient sink retaining approximately 63% of the total phosphorus and 25% of total nitrogen (Snyder and Minnshall 1994). Analysis of macrozooplankton in the Kootenai River indicate a paucity of important fish foods such as *Daphnia*, *Diaphanosoma*, and *Cyclops*. Total densities of zooplankton in the Kootenai River were usually <0.1 organism/L, which was among the lowest in comparison to other Pacific northwest rivers (Williams 1961). Also, total densities of zooplankton in the river during 1994 were 100-fold lower than densities in Lake Koocanusa during the mid-1980s (D. Skarr, Montana Department of Fish, Wildlife, and Parks, personal communication) and about 200-fold lower than the mid-region of the South Arm of Kootenay Lake in 1993 (L. Thompson, British Columbia Ministry of Environment, personal communication). It should be noted that zooplankton densities in fluvial waters are normally lower than lucustrine waters (Eddy 1932 and Cushing 1964). But the differences between the river and lakes are quite dramatic.

Lower productivity of the Kootenai River has likely affected some fish populations because of lower food abundance. I found that the standing stock of mountain whitefish in 1993 was lower than that determined by Partridge (1983). This lower standing stock has also affected trophic structure of the fish community in the Kootenai River. I analyzed the trophic structure of the fish community of the Hemlock Bar sampled by Partridge in the early 1980s (1983) and found it to be comprised equally of insectivores (primarily mountain whitefish) and omnivores (Catostomids) (Figure 11). The same analysis of the fish community sampled in 1993 indicated a shift in trophic structure to a dominance of omnivores (Catostomids) and substantially fewer insectivores (mountain whitefish) (Figure 7). Paragamian (1990) found changes in the trophic structure of fish communities were usually indicative of environmental alterations to the river. In addition, I found back-calculated growth of mountain whitefish sampled in 1993 to be slower than fish sampled in the early 1980s (Partridge 1983) (Figure 12). The greatest incremental changes appeared to occur after age 1, with a difference of about 35 mm at age 2 and 50 mm at age 5. The slower growth of mountain whitefish could not be due to increased densities because it is now several fold lower (about 480/hectare vs 117/hectare), but is most likely due to the lower productivity/carrying capacity of the Kootenai River. Marcuson et al. (in press) found negligible growth of white sturgeon in the Kootenai River; some sturgeon had been tagged for over 15 years before recapture. In addition, growth of rainbow trout in the Kootenai River is slower than at least one other river in north Idaho (Figure 13). It is not known for sure how this reduction in productivity may have affected burbot, but it could have reduced survival of fry, lowered the carrying capacity, or reduced fecundity.

Loss of productivity could also be due to other environmental changes, such as the reversed hydrograph and power peaking. Variations in stream discharge has been known to cause changes in invertebrate abundance, productivity, and species composition (Cushman 1985). Rimmer (1985) artificially reduced discharge in seminatural river channels and depressed the growth of rainbow trout. Trotzky and Gregory (1974) found low discharges below a power dam resulted in dewatered side channels and resulted in reduced aquatic insect biomass. Regardless of the factors that have reduced productivity, it is becoming increasingly clear that the fish species affected most are those that spend at least part of their life in Kootenay Lake, e.g. burbot, white sturgeon, and kokanee. Any efforts to improve the productivity of the Kootenai River and perhaps the lower South Arm of Kootenay Lake, such as fertilization or improved water management, will benefit most fisheries.

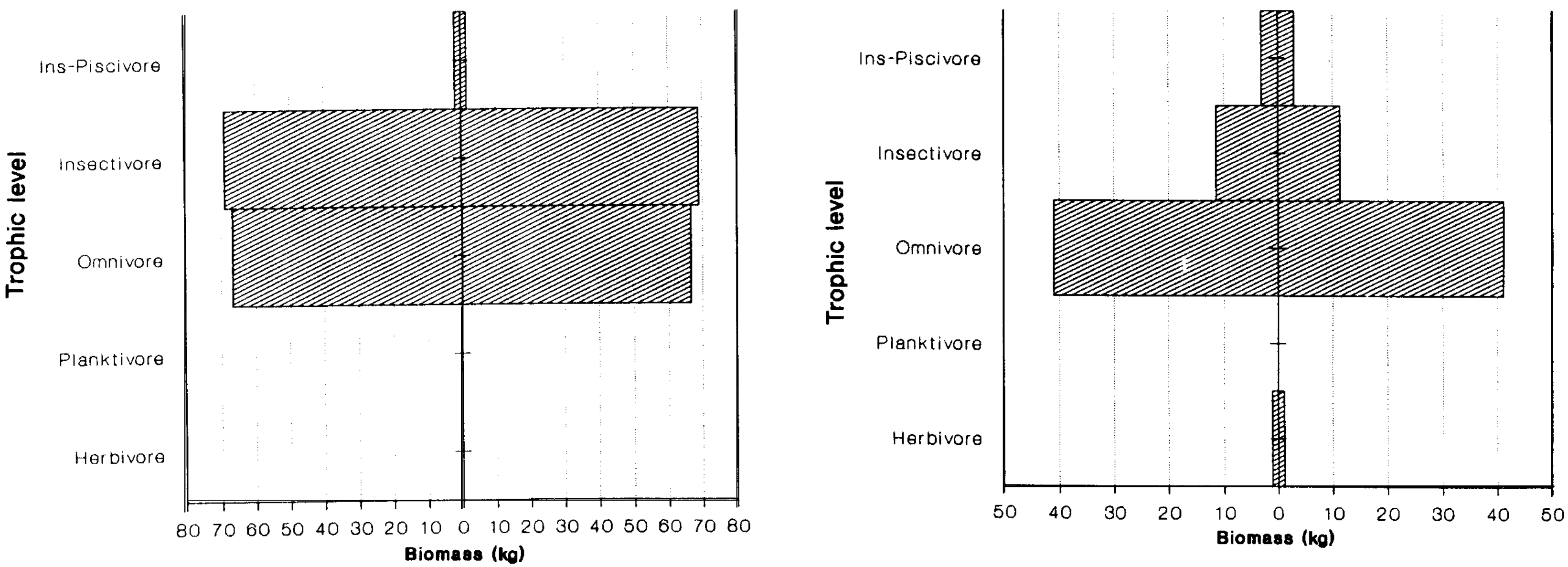

Figure 11. Trophic structure of the fish community of two reaches of the Kootenai River. The left figure is the Hemlock Bar community and the right figure is the Porthill community. Data is from Partridge (1983); samples taken by electrofishing, July 1982.

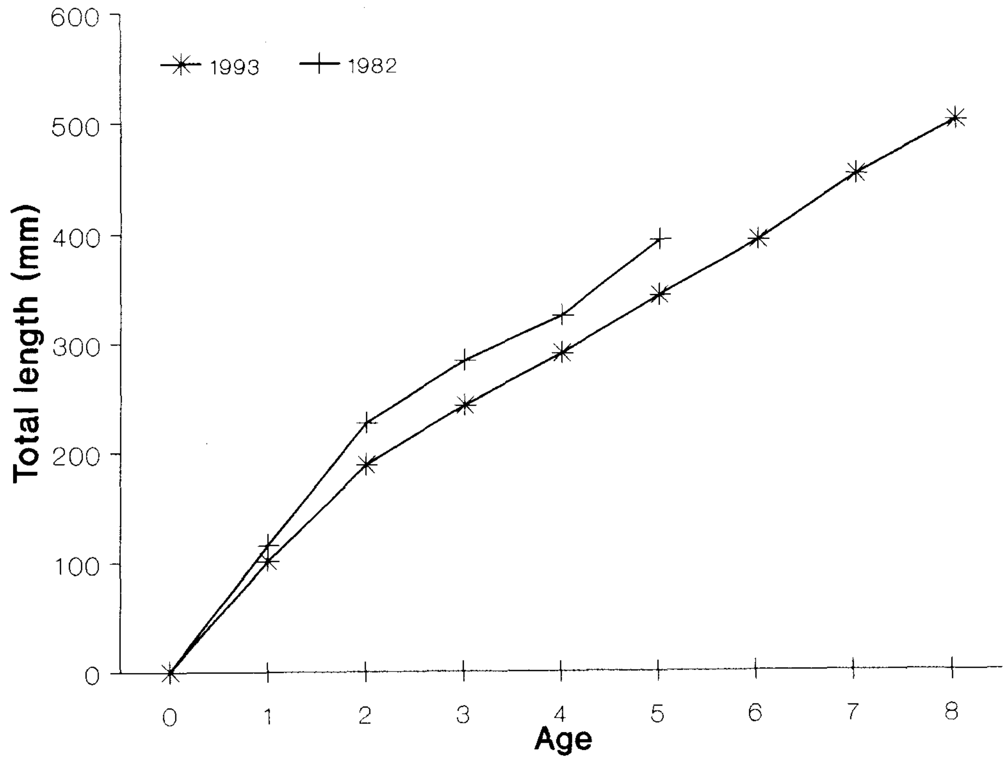

Figure 12. Back-calculated length at age for mountain whitefish in the Kootenai River, 1982 (Partridge 1983) and 1993.

Figure 13. Back-calculated total length of rainbow trout in the Kootenai and Spokane rivers (Davis 1991).

Trout and Tributary Streams

We sampled 22 streams from 1993 (Paragamian 1994) through 1994, the same streams inventoried by Partridge (1983). Comparison of our electrofishing catch to that of Partridge is limited since he did not calculate CPUE and the efficiency of our gear may have differed. But single pass electrofishing of Partridge (1983) and mine suggests there has been no change in the relative abundance of trout in nursery streams to the Kootenai River drainage in Idaho. The exception, 56 rainbow and cutthroat trout were caught in Burton Creek during the earlier study, while 10 were caught in 1993. However, this point should be viewed with considerable caution because these streams are in continuous jeopardy of environmental degradation that have already created immense problems at other north Idaho tributaries. Also, since these comparisons are based on a single pass catch, I made population estimates of some stream reaches to aid further studies.

Few adult trout are year-long residents of the tributaries we sampled in 1993 and 1994. Partridge (1983) found few adults in his inventory work, but reported runs of adult trout into the tributaries in Idaho were smaller than those reported by May et al. (1981) for tributaries in Montana.

Sport Fishery

Our findings indicate fishing pressure on the Kootenai River has changed little since 1982 and is very low compared to other river fisheries in the Panhandle Region. The 1993 creel through August covered a similar time span as that of Partridge (1983); January through August 1982. We estimated an angling effort of 13,698 h at 129 h/km (± 36), while Partridge (1983) estimated an effort of 102 h/km. Anglers fishing the North Fork of the Coeur d'Alene River and the Little North Fork of the Coeur d'Alene River fished about 1,026 h/km and 103 h/km, respectively, in 1992 (Davis and Horner 1993). These two streams are small bodies of water by contrast to the larger Kootenai River. On the other hand, a 19.4 km reach of the Spokane River had 6,193 h of effort in 1990 (Davis 1991).

Catch rates on the Kootenai River have declined and are unacceptable for a viable sport fishery (Fish Management Plan 1991 - 1995). Anglers fishing for trout caught 0.03 trout/h in 1993, whereas the catch was 0.06 trout/h in 1983 (Partridge 1983). Anglers fishing the Spokane River in 1990 had substantially better fishing success at 0.3 trout/h (Davis 1991), while anglers fishing the North Fork of the Coeur d'Alene River and the Little North Fork of the Coeur d'Alene River in 1992 caught 0.73 and 0.67 trout/h (Davis and Horner 1993). It should be noted, a substantial portion of the catch from these streams were hatchery releases. Partridge (1983) estimated a harvest of 1,449 whitefish in 1982 as compared to 984 during the same time frame in 1993 (Table 5), while the total harvest for an entire year was 1,168 (± 923). This comparison is limited by the low number of angler interviews. However, I believe the lower harvest is probably indicative of the reduced density of mountain whitefish.

Rainbow Trout Synopsis

The rainbow trout has been the most sought after fish in the sport fishery. There have been only two creel surveys on the Kootenai River. The estimated harvest from March 1 to August 14, 1982 was 448 fish (Partridge 1983). But harvest of rainbow trout during the same time frame in 1993 was about 700 fish (Table 7). Harvest from March 1, 1993 to February 29, 1994 was estimated at 1,040 fish (± 905). The broad confidence interval from the recent creel is probably due to the fact so few fisherman were interviewed. One reason for the rather stable rainbow trout fishery may be due to the fact that unlike other sport fish, most juveniles are thought to spend their early years in tributary streams. About 77% of the rainbow trout caught in the tributaries were <80 mm. Comparison of data from nursery streams from this study and that of Partridge (1983) have shown similar densities of juvenile rainbow trout. Total electrofishing catches from the Hemlock Bar averaged 40 fish from 1980 to 1982 and was 27 after four trials in 1993. It is not known if growth of rainbow trout has changed since the earlier study, but condition factors are slightly higher; an average of 1.0 from 1980 to 1981 and 1.15 in 1993. Habitat protection and preservation of the nursery streams is an important factor to maintain the rainbow trout fishery in the Kootenai River. Partridge (1983) reported a decline in the quality of spawning habitat for rainbow trout.

RECOMMENDATIONS

1. Continue implanting burbot with sonic transmitters to determine habitat preferences, movement patterns, behavioral activities, and spawning locations. This data base can be used to develop instream flow needs and habitat suitability curves.

2. Determine the winter distribution and movement of burbot from Kootenay Lake into the lower river between Boundary Creek and Goat River, British Columbia. This may provide evidence of the distance of a spawning run from Kootenay Lake.

3. Determine if winter discharge levels in the Idaho reach of the Kootenai River present velocity barriers to upstream movement of burbot.

ACKNOWLEDGEMENTS

Vern Ellis, Pat Marcuson, Gretchen Kruse-Malle, and temporary employees of IDFG assisted with field work and some data summary. Karen Huber prepared most tables and appendices, while Melo Maiolie and Virgil Moore reviewed and edited the report. Funding for this work was provided by Bonneville Power Administration, Project Number 88-65, to implement activities of the Northwest Power Planning Council.

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A P P E N D I C I E S

Appendix A. Ling fishing questionnaire.

State of Idaho
Department of Fish and Game
2320 Government Way
Coeur d'Alene, ID 83814

4 October 1993

Ling Fishing Questionnaire

Name ____________________
(Voluntary)

1. Did you ever fish for ling in the Kootenai River?_______

2. When was the last time you caught a ling?_______________

3. What was the most ling you caught in one day by rod and reel?__________

   by set line?_______

   by spearing?_______

4. What was your best year for ling fishing?____________

5. When did you notice a decline in your catch of ling?________

6. Do you still fish for ling?__________

7. Did you catch a ling this last summer?_________

8. If you were to fish for ling in the Kootenai River where would be the best spot?____

   ____

9. Where was the best place to fish for ling?_________________

10. Would you be willing to walk a stream in January to look for adult ling and is that the best time to look for ling in streams?____

    ____

Thank you,

Vaughn L. Paragamian
Senior Fisheries Research Biologist

Appendix B. Location (rkm), date, depth, and water temperature °C of burbot 446 as determined by sonic telemetry and X16 Lawrence graph recorder.

Date	Location (RKM)	Depth (m)	Water temperature °C
24 Nov 93	244	18.3	--
6 Dec 93	244	--	--
10 Dec 93	244	--	--
13 Dec 93	244	--	--
15 Dec 93	244	--	--
17 Dec 93	244	--	--
20 Dec 93	244	9.8	--
29 Dec 93	244	10.7	--
7 Jan 94	244	--	--
12 Jan 94	244	19.2	--
12 Jan 94	244	17.1	--
18 Jan 94	244	16.9	--
20 Jan 94	244	19.2	--
24 Jan 94	244	17.4	--
26 Jan 94	244	7.6	4
27,28,29	244	8.2	--
Jan 94	244	7.6	--
	244	8.2	--
	244	7.6	--
	244	8.8	--
	244	9.1	--
	244	10.1	--
31 Jan 94	244	4.3	3
3 Feb 94	246	1.1	2
3 Feb 94	246	1.1	2
15 Feb 94	244	1.2	--

Appendix C. Location (rkm), date, water temperature°C, and depth of burbot 374 as determined by sonic telemetry and X16 Lawrence graph recorder.

Date	Location (RKM)	Depth (m)	Water temperature °C
15 Dec 93	244	--	--
17 Dec 93	244	10.7	--
20 Dec 93	244	19.5	--
7 Jan 94	244	10.4	--
15 Feb 94	228	8.2	3
22 Feb 94	230	9.1	--
1 Mar 94	230	9.1	--
4 Mar 94	229.7	7.3	5
5 Mar 94	228	--	--
6 Mar 94	227	--	
8 Mar 94	230	--	--
10 Mar 94	232	1.4	4 "found dead"

Appendix D. Location (rkm), date, water temperature °C, and depth of burbot 455 as determined by sonic telemetry and X16 Lawrence graph recorder.

Date	Location (RKM)	Depth (m)	Water temperature °C
Released 19 Mar 94	232	--	--
19 Mar 94	233	6.1	8.5
25 Mar 94	236	6.1	6.0
2 Apr 94	237	11.3	7.0
5 Apr 94	237	7.6	8.5
10 Apr 94	233	12.2	--
12 Apr 94	212	16.2	12.0
13 Apr 94	209	9.5	11.0
2 Jul 94	115.5		

Appendix E. Location (rkm), date, water temperature °C, and depth of burbot 365 as determined by sonic telemetry and X16 Lawrence graph recorder.

Date	Location (RKM)	Depth (m)	Water temperature °C
10 Apr 94	244.6	10.7	6.0
13 Apr 94	244.6	14.3	6.0
19 Apr 94	244.6	--	--
25 Apr 94	244.7	7.0	4.5
27 Apr 94	244.7	18.3	8.0
29 Apr 94	244.6	18.6	7.5
3 May 94	244.0	14.6	9.0
19 May 94	244.0	17.4	8.5
9 Aug 94	247.5	3.0	--
9 Aug 94	247.5	3.0	--

Appendix F. Location, date, depth, water temperature °C of burbot 96 as Determined by sonic telemetry and X16 Lawrence graph recorder.

Date	Location (RKM)	Depth (m)	Water temperature °C
7 Jul 94	177.2	--	--

Appendix G. Location, date, depth, water temperature °C of burbot 383 as determined by sonic telemetry and X16 Lawrence graph recorder.

Date	Location (RKM)	Depth (m)	Water temperature °C
7 Jul 94	177.2		
8 Jul 94	177.2		
11 Jul 94	177.7		
20 Jul 94	177		
27 Jul 94	177		
28 Jul 94	177.3		
5 Aug 94	177.2		
9 Aug 94	177.2	7.0	
12 Aug 94	177.2	8.2	
15 Aug 94	177.3	13.7	
15 Aug 94	177		
16 Aug 94	177		
16 aug 94	177		
25 Aug 94	177		
31 Aug 94	177		
2 Sep 94	177		
6 Sep 94	177		
7 Sep 94	177		

Appendix H. Average back calculated total length (mm) at each annulus for each year class of mountain whitefish captured in the Kootenai River, Idaho, 1993.

		Age						
Year class	Number	1	2	3	4	5	6	7
1992	50	90						
1991	31	89	120					
1990	28	91	121	140				
1989	25	93	118	139	175			
1988	19	90	122	141	176	200		
1987	5	91	130	142	174	207	250	
1986	1	90	129	139	172	189	249	300
Total	159							
Grand average		91	123	140	174	199	250	300

Appendix I. Average back calculated total length (mm) at each annulus for each year class of rainbow trout captured in the Kootenai River, Idaho, 1993.

		Age				
Year class	Number	1	2	3	4	5
1991	5	73	214			
1990	16	67	147	228		
1989	5	66	157	258	322	
1988	1	67	109	217	336	414
Total	27					
Grand average		68	160	234	324	414

Appendix J. Single run electrofishing catch from 16 tributaries of the Kootenai River, Idaho, July through August 1993.

Stream	Effort (minutes)	Mountain whitefish	Rainbow trout	Cutthroat trout	Squawfish	Brook trout	**Bull** trout	Sucker	Longnose **dace**	**Bedside** shiner	Sculpin°	Total Catch
Debt Creek'	20.1	0	11	0	0	0	0	0	0	0	1	12
Caboose Creek	54.4	0	1	1	0	3	0	0	0	0	1	6
Curly Creek	53.1	0	3	0	0	11	0	0	25	0	1	40
Cow Creek	93.5	0	11	0	0	1	0	0	0	0	0	12
Dodge Creek	59.8	0	45	0	0	9	0	0	0	0	0	54
Moyie River	49.0	0	0	0	5	0	0	0	34	7	18	64
Trail Creek	73.4	0	459	0	4	42	0	0	32	0	31	568
Falls Creek A	158.8	1	171	0	1	17	0	0	70	4	33	297
B'	63.5	4	134	0	0	46	0	0	40	5	31	260
Ruby Creek' A	57.4	1	186	0	0	47	0	2	75	0	0	311
B[b]	43.2	8	407	0	0	26	0	0	75	0	0	516
Mission Creek[b]	19.0	0	0	43	0	128	0	0	0	0	17	188
Boulder Creek	85.1	9	133	0	0	5	0	0	58	0	40	245
Deep Creek A'	73.6	0	48	0	0	3	0	0	60	0	53	164
B	25.9	5	4	0	--	0	0					
Twenty Mile	27.5	0	129	0	0	21	0	0	0	0	0	150
Long Canyon'	49.7	6	11	0	0	4	1	0	4	0	11	37
Snow Creek'	77.5	0	99	0	0	15	0	0		0		114

[a] Represents catch from first trial of population estimate.
[b] Data from Brian Hoelscher, Idaho Department of Environmental Quality.

Appendix K. Single run electrofishing catch per hour of effort from 16 tributaries of the Kootenai River, Idaho, July through August 1994.

Stream	Effort (minutes)	Mountain whitefish	Rainbow trout	Cutthroat trout	Squawfish	Brook trout	Bull trout	Sucke	Longn dace	Bedside shiner	Sculpin	Total Catch
Debt Creek	20.1	0	32.8	0	0	0	0	0	0	0	3.0	35.8
Caboose Creek	54.4	0	1.1	1.1	0	3.3	0	0	0	0	1.1	6.6
Curly Creek	53.1	0	3.4	0	0	12.4	0	0	28.2	0	1.1	45.1
Cow Creek	93.5	0	7.1	0	0	.6	0	0	0	0	0	7.7
Dodge Creek	59.8	0	45.1	0	0	9.0	0	0	0	0	0	54.1
Moyie River	49.0	0	0	0	6.1	0	0	0	41.6	8.6	22.0	78.3
Trail Creek	73.4	0	375.2	0	3.3	34.3	0	0	26.2	0	25.3	464.3
Falls Creek A	158.8	.4	64.6	0	0.4	6.4	0	0	26.4	1.5	12.5	112.2
B	63.5	3.8	126.6	0	0	43.5	0	0	37.8	4.7	29.3	245.7
Ruby Creek A	57.4	1.0	194.4	0	0	49.1	0	2.1	78.4	0	0	325.0
B	43.2	11.1	565.3	0	0	36.1	0	0	104.2	0	0	716.7
Mission Creek	19.0											
Boulder Creek	85.1	6.3	93.8	0	0	3.5	0	0	40.9	0	28.2	172.7
Deep Creek A	73.6	0	39.1	0	0	2.4	0	0	48.9	0	43.2	133.6
B	25.9	11.6	9.3	0		0	0		--		--	20.9
Twenty Mile	27.5	0	286.7	0	0	45.8	0	0	0	0	0	332.5
Long Canyon	49.7	7.2	13.3	0	0	4.8	1.2	0	4.8	0	13.3	44.6
Snow Creek	77.5	0	76.6	0	0	11.6	0	0	0	0	0	88.2

Appendix L. Monthly mean density (N/L) and range of zooplankton sampled at Ambush Rock of the Kootenai River during midday verticle haul, 1994.

Month	Cyclops Mean	range	Cyclops Mean	range	Diaptomus Mean	range	Epischura Mean	range	Ergasilus Mean	range	Daphnia Mean	range	Diaphanosoma Mean	range	Bosmina Mean	range	Total	
Jan	.18	.09-.33	.01	0-.02	.02	0-.02	.01	0-.01	.0	0-0	.0	0-0	.0	0-0			.21	.11-.37
Feb	.22	.15-.30	.15	.04-.29	.0	0-0	.0	0-0	.0	0-0	.0	0-0	.0	0-0			.37	.19-.49
Mar	.16	.08-.22	.04	.02-.06	.0067	0-.01	.0	0-0	.0033	0-.01	.0	0-0	.0	0-0			.21	.13-.28
Apr	.0033	0-.09	.0	0-0	.0	0-0	.0	0-0	.0	0-0	.0033	0-.01	.0	0-0			.0367	0-.10
May	1.74	.86-2.64		1.04-3.27	.0	0-0	.0	0-0	.0	0-0	.0	0-0	.0	0-0			3.71	1.90-5.90
Jun	.067	.04-.10	.0233	.0-.05	.0067	.0-.05	.0067	.0-.02	.0	0-0	.0	0-0	.0	0-0			.0933	.06-.14
Jul	.0033	0-.01	.0	0-0	.0	0-0	.0	0-0	.0	0-0	.0	0-0	.0	0-0			.0033	0-.01
Aug	.0133	.0-.02	.0	0-0	.0	0-0	.0	0-0	.0	0-0	.0	0-0	.0067	0-.02	.0033	0-.01	.02	.01.03

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